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Crowd Ingress to Places of Assembly: Summary and Proceedings of an Experts' Workshop

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
National Engineering laboratory
Center for Building Technology
Washington, DC 20234

July 1981

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CROWD INGRESS TO PLACES OF ASSEMBLY: SUMMARY AND PROCEEDINGS OF AN EXPERTS' WORKSHOP

Francis T. Ventre
Fred I. Stahl
George E. Turner

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
National Engineering Laboratory
Center for Building Technology
Washington, DC 20234

July 1981

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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

ABSTRACT

The movement of large crowds into places of assembly has resulted in death and injury to facility patrons and staff. Facility designers and managers seeking guidance have found little relevant information in the technical literatures of architectural and crowd control.

The Law Enforcement Assistance Administration and the National Bureau of Standards convened the most knowledgeable persons in North America in the topic of crowd ingress to places of assembly to: identify best current design practices; identify best current facilities management practices; and define research needed to support improved practices in design and management.

The report documents the design and management practices suggested by the assembled experts, reports related activities of the International Association of Auditorium Managers and suggests a research approach that could lead to improved quantitative design and evaluation procedures for crowd ingress.

Key Words: Auditorium; building standards, crowd ingress; design procedures; evaluation procedures; facility design; facility management; public assembly; public safety; stadiums.

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1.0 PURPOSE AND AUDIENCE

On the evening of December 3, 1979, eleven people died (and about the same number were injured) attempting to enter the Cincinnati Riverfront Coliseum to attend a rock concert. Thus did the United States rejoin the list of countries where uncontrolled crowding has resulted in significant casualties and loss of life. Consider these incidents: 1971, Glasgow Scotland Soccer Stadium, 66 dead; 1975, at a soccer stadium near Buenos Aires, two dead; 1976, Rio de Janeiero, Brazil at a faith healing service, 21 dead. Since the Cincinnati tragedy, six persons lost their lives rushing to see Pope Paul II during his visit to Fortaleza, Brazil in 1980. And on February 8, 1981, a stampede of spectators trying to force their way out of a crowded Athens, Greece soccer stadium killed 24.

Crowding occurs normally in many human activities. Tens of thousands of pedestrians course daily through transportation terminals, high rise buildings, stadiums and auditoriums and at numerous public locations indoors and out. Most of this routine crowd movement causes only annoyance, with minimal social and economic cost. Yet the risk of a recurrence of death by crowding has become a critical life safety consideration to public authorities in the immediate locales of the incidents cited above and to life safety professionals the world over. National attention grew across America for several reasons. First, the death and injury from crowding had "hit home": Cincinnati, Ohio had suffered something that had in recent years occured only in foreign countries; second, the development of mass audiences--largely encouraged by the electronic media--and the creation of scores of new large-capacity stadiums and arenas had increased the likelihood that very large

crowds would gather for leisure and cultural events.

The City of Cincinnati's response to the Riverfront Coliseum tragedy went beyond the to-be-expected enactment of emergency crowd control and safety ordinances. The City established a task force to investigate public safety and crowd control at large public and private gatherings. The Cincinnati Task Force on Crowd Control and Safety began its work expecting that "many of the issues that it addressed will hold national interests as well."[1] This report is one manifestation of that interest.

The Task Force, meeting over six months and consulting many experts, considered subjects ranging from crowd management, planning and standards, seating, police policies, emergency medical services, to pedestrian processing. The Task Force's widely circulated report directed over one hundred recommendations to "all parties who are responsible for and participate in [large scale public] events."[2]

Professionals responsible for the operations and management of facilities for public assembly as well as the architectural and engineering designers of those facilities are concerned for the safety and well being of the public using those facilities. The designers' responsibility was reaffirmed within months of the Cincinnati incident when New York State's highest appellate court ruled that designers are liable to injured building users for negligent design even though the defect might have been observable and apparent to the building owner and the injury occurs many years after the designer had performed his services.[3]

---

[1]Numbered footnotes refer to citations in Chapter 5.

This New York Court of Appeals ruling has encouraged all conscientious facilities managers and building designers to seek the best guidance for their future designs and operations. Unfortunately, building designers have very little reliable guidance on ingress available to them. A close reading of widely used references, handbooks and design guidelines yields few specifics. There are very few quantitative design algorithms and almost no evaluated experience on which to base designs for places of public assembly in which the potential for hazardous crowd behavior exists. Does the research community have more to offer? Yes and no. While there is a sizable archival research literature on dynamics of crowds, most of this deals with rioting and other civil disturbances.* There is a growing research literature from U.S. and foreign research centers on pedestrian movement.4-16 But these deal mainly with steady flows under normal circumstances or emergency exiting from building fires. A technical basis in the research literature simply is not available to assist designers in dealing with pedestrian traffic now associated with ingress to places of assembly.

NBS' search of the documented research literature yielded little of immediate practical use. Consequently, a workshop was organized to which were invited the most knowledgeable persons in North America on the topic of crowd ingress to places of public assembly. This report is based on the proceedings of that Workshop.

The primary purpose of this report is to provide practical suggestions developed by the experts for the use of designers as they develop plans and designs for newly-built or refurbished places of public assembly.

*See Appendix E for an annotated bibliography.

It will be helpful to facilities owners and managers as they continually revise and improve operating practices in and around their facilities. An important secondary purpose is to identify what research approaches might yield the new knowledge needed as a basis for improved design and management practices in the future.

2.0 LEAA/NEL WORKSHOP ON CROWD INGRESS TO PLACES OF ASSEMBLY

The Cincinnati Task Force in its final report explicitly recommended that the National Bureau of Standards (NBS) review existing regulations concerning pedestrian and crowd movement and initiate new research in the area of building ingress. The Task Force was led to this recommendation by their finding that Federal government attention was drawn primarily to exiting requirements and not much attention was directed to the process of entering buildings. Moreover, it found that many facility ingress design decisions are based on egress design criteria published by NBS in 1935.[17]

While recent NBS pedestrian movement research and experience is primarily focused on physical characteristics of buildings and their environs, the Task Force's report indicated that public safety agencies, such as the local police, have a key role in effective crowd management. Law enforcement policies received chapter-length treatment and six recommendations in the Task Force report. Consequently, NBS sought the cooperation of the Federal agency that sponsored much of the crowd control research cited in Appendix E of this report and has strong links to local police departments. The Department of Justice's Law Enforcement Assistance Administration (LEAA) agreed to cosponsor with the NBS National Engineering Laboratory a workshop on crowd ingress to places of public assembly and bring to bear its experience in dealing with state and local law enforcement agencies also concerned with maintaining public safety and order. LEAA's participation ensured that law enforcement considerations would be more fully represented and that the workshop recommendations would receive a wide distribution among the government agencies responsible for public safety.

The Cincinnati Task Force explicitly recommended that the National Bureau of Standards (NBS) review existing regulations concerning pedestrian and crowd movement and initiate new research in the area of building ingress:

> 1. The National Bureau of Standards should review existing regulations concerning pedestrian and crowd processing in, through and out of buildings, and embark on new studies directed at establishing new regulations where appropriate.
>
> 2. The National Bureau of Standards should initiate new research into the changing pedestrian flow patterns with emphasis on, but not limited to, high density rates, ingress flows, ticket processing, entrance configurations, the influence of environmental variables and crowd dynamics in high density situations.[18]

The Crowd Ingress Workshop was convened at NBS on May 4, 1981 to address physical design and crowd management practices in places of public assembly.**

The Workshop's morning session heard the participating experts relate their respective overviews of the problems of crowd ingress to places of assembly, drawing almost totally on their direct professional experience at large facilities in all regions of the U.S. and in several foreign countries. Some augmented their previously submitted position papers, others related new data. Issues that seemed to the assembled experts to be particularly significant and of more than local usefulness were recorded for later reference. That listing by the mid-afternoon had grown to 22 items of continuing concern to both designers and managers present. Table 1 lists those items.

** The Workshop agenda is Appendix A. The list of participants is Appendix B. Technical background material distributed by NBS to the participants in advance of the workshop is Appendix C. Position Statements submitted to the Workshop is Appendix D.

TABLE 1

WORKSHOP IDENTIFIED 22 ITEMS OF CONCERN	AFFECTING PRACTICES IN FACILITIES DESIGN (F) AND MANAGEMENT (M) (AND OFTEN BOTH SIMULTANEOUSLY)
1. INTERFACE TO TRANSPORTATION.	F
2. CONCOURSE - PLACE TO WAIT.	F
3. COMMUNICATION TO CROWD.	M
4. SECURITY - VISIBLE - WHILE WAITING.	M
5. BREAKDOWN CROWD PRIOR TO DOOR.	F,M
6. LETTING ONLY PROPER PEOPLE IN.	M
7. LETTING ONLY PROPER THINGS IN.	M
8. NUMBER AND LOCATION OF ENTRANCES.	F
9. UNDERSTANDING CROWD CHARACTERISTICS, ATTITUDES, PHYSICAL CONDITION.	F,M
10. EDUCATION FOR CUSTOMERS.	M
11. EDUCATION FOR MANAGERS/STAFF.	M
12. CONTROL TIMES OF ARRIVAL.	M
13. DESIGN DOORS FOR INGRESS.	F
14. AVOID CROWD CONCENTRATION.	F,M
15. PROVIDE FOR REFUNDS, TICKET ADJUSTMENTS.	M
16. SUPERVISE TICKET TAKERS.	M
17. SECOND LEVEL OF DEFENSE WHEN PROBLEMS OCCUR.	F,M
18. DEALING ADEQUATELY WITH EXISTING FACILITIES.	M
19. INFORMATION FROM FACILITIES MANAGERS CLEARINGHOUSE (INTERNATIONAL).	M
20. INFORMATION FROM DESIGNERS.	F,M
21. SEPARATION OF TICKETING AND ADMISSION.	F,M
22. ORIENTATION/DIRECTIONAL GRAPHICS.	F,M

The Workshop then entered a round table discussion focused on individual crowd ingress problems documented in the materials distributed to the participants in advance and found in Appendix C to this report. J. L. Pauls of the National Research Council of Canada led a discussion of crowding based on his Preliminary Report of Observations at CNE Stadium, Toronto. Dr. Randall W.A. Davidson offered to the Workshop his "Historical and Behavioral Perspective on Risk Management for Public Assembly Gatherings".

During the afternoon session the Workshop participants viewed and discussed films, videotape and still photographs of critical events at public gatherings ranging from the 1976 Montreal Summer Olympics to a Country and Western Music Concert at Lexington, Kentucky. In each case, the visual presentation was augmented by very knowledgeable and perceptive running commentary. These presentations reminded many participants of the value of reliable documentation of crowd behavior and the need for consistent documentation methods to facilitate incident-to-incident and location-to-location comparisons. This point is discussed further in Chapter Four of this report.

The tables in Chapter 2 and 3 of this report list issues that concerned the Workshop and the practices recommended for dealing with many of them. The tables present this information compactly, but the tables cannot convey the richness of the discussion from which the recommendations were distilled. Space does not permit a complete transcription, but the following paragraphs carry some of the flavor of the Workshop discussions.

Aaron Siegel, Manager of the Philadelphia Spectrum, observed at the outset of the Workshop that the nature of the event was the single most critical factor in crowd management. The nature of the event determined two things: the type of crowd: singles, couples, groups; and the means of arrival: public transit, private automobiles. These factors are relatively fixed and can be anticipated. Weather and "mood", acknowledged by all to be influences, are so highly variable and transient that no prudent manager or designer can hope to anticipate their combined effects. (Their single effects are not that reliably known, either, according to some of the participants.)

Robert Sigholtz, Manager of the Washington, D.C. StarPlex and Washington representative of the International Association of Auditorium Managers (IAAM) remarked to the Workshop that many of the problems associated with crowd ingress to places of public assembly are the unanticipated consequences of well-intentioned but poorly researched laws, ordinances and regulations--many of them enacted under the stress of a recent calamity. Compounding this, said Dr. Sigholtz, is the widespread use of "amateurs" as facilities managers. The IAAM's members manage about 1250 auditoriums, arenas, stadiums and convention/exhibition halls the world over. The organization advised the Workshop that safe and efficient crowd ingress practices are in use in many places and that the very best practices should be documented for wide distribution to the large numbers of beginning facilities operators. IAAM's position is stated in Appendix D of this report.

What do we reliably know about how crowds enter places of assembly? J. L. Pauls, of the National Research Council of Canada, stated that

normal crowd movement is so well understood it has become predictable. under certain circumstances. When probed by Workshop Chairman Richard N. Wright to consider if the predictive models were reliable enough to guide design and management to avoid emergencies, Pauls answered affirmatively, stating that some movement conditions such as flow are now predictable within $\pm$4% so that the research remaining to be done stands a high chance of success. (This is considered again in Chapter 4.) While success is at hand for predicting normal flows, Irwin Benjamin of the NBS Center for Fire Research asked if anyone could predict when "normality" would end and "trouble" (neither term further defined) would begin.

At this point, the previous discussion of the self-selected composition of crowds and the typing of crowds by the nature of the event was reinforced. Randall Davidson, longtime consultant to the entertainment and insurance industries, described the emergence of a significant fraction of crowd members who join crowds and seek to enter places of assembly but who are not basically interested in the performance at all. They are attracted to the crowd in order to traffic in contraband, to engage in prostitution or to steal from the unsuspecting. The job of the facility manager grows significantly in that all the managers in the discussion expressed a responsibility to the larger crowd and to the larger society to isolate and deny access to the aberrant spectator mentioned by Davidson. This compounds the immediate problem of facilitating timely crowd ingress, but the Workshop left no doubt that a facility's problem would worsen if spectators were permitted to prey on other spectators.

"Design can move a problem to a place where it can be better handled". Aaron Siegel's immediate reference was to many managers' preference for controlling unwanted behavior out on the site rather than allowing the "problem" to enter the building itself. The experts felt that greater physical property damage and personal injury is probable and the contagion of aberrance or lawlessness more likely indoors (in closely-confined spaces) than out. The managers repeated this throughout the Workshop: They willingly trade one problem for another if the new problem is even slightly more tractable.

Talbot Wilson, an architect-member of the team that designed the Houston Astrodome, led off the discussion of how physical characteristics of places of public assembly affect crowd ingress. Dispersion and redundancy were frequently cited attributes of the more successful places of assembly (Wilson has visited large-scale facilities in many cities and urges other designers to do so, in the company of the manager or manager-designate of th facility being designed). Not only should entrances to the facility occur all around the periphery of the structure, he said, but physical space, aided by directional graphics, should be used to clarify to the crowd what processing functions are taking place: where and in what order. For instance, ticketing must be separated from admissions and the flow between these stations must be uni-directional.

Redundancy had both a spatial and communications meaning to the Workshop participants. Just as environmental graphics--color coded tickets, seats, doors, symbols, and banners--orient and direct crowds by reinforcing the

spatial flow through a place of assembly, audible messages--that begin well-outside the structure itself--keep the spectators (and the staff, too, incidentally) apprised of what's happening and when. The audible messages not only keep the facility management present even when not seen, but preempt the formation and propagation of rumours--such as an impending cancellation of the feature event. The provision of an audible communication system (not just the program-related "public address (PA)" or sound system) is just the sort of capability that the designer must provide for the manager's later deployment. What are others?

Paul Wertheimer, who served as Chief of Staff of the City of Cincinnati's Task Force on Crowd Control and Safety, turned the discussion towards specifics when he asked about door performance and the prospects for improved technology. Like most building elements, doors serve several functions simultaneously: control ingress, control egress, manage flow, assist in orientation, an acoustical barrier, an energy leak, a work station for the security force. With air supported structures increasingly used for places of public assembly, (a trend, incidentally, most of the facilities managers present thought would accelerate) the door assemblies will be forced to cope with more functions than at present.

But decisions about doors--a specific architectural design decision--cannot be made on "hardware" grounds alone because the number and placement of doors is intimately related to the staffing plan for the facility. These decisions cannot be taken independently and physical design must be melded with management policies. Facility design decisions, in the opinion of most of the participants,

require the close collaboration of designer and operator. Paul Wertheimer raised this point with his observation that even the best design cannot anticipate every or even most of the crowd behaviors from the most benign and gentle to the most obstreperous. Only management has the dynamism to adapt to changing conditions depending on the type of crowd. This means that the physical design must not pre-empt significant choices among crowd management practices. Support for this approach recurred several times throughout the Workshop.

3.0 WHAT THE ASSEMBLED EXPERTS CONCLUDED

The Workshop participants concluded that designers and facility managers could deal more effectively with problems of crowd ingress, often by adapting to their own local situations practices that succeeded at other times and places. In other words, while there is neither systematic nor complete knowledge about crowd ingress to places of assembly, there is a great deal of uncodified and usually unwritten lore to be shared. And share it the participants willingly did. Consider first management issues.

No systematic guidance for crowd management is now available. But, as is detailed in Chapter Four, preparation of such guidance has been proposed by the International Association of Auditorium Managers (IAAM). A number of successful practices were mentioned in the course of the Workshop and they are summarized in Table 2. The Table is organized in chronological order beginning well in advance of the event itself and is structured according to a sequence of fairly discrete, definable stages of crowd formation, movement and settlement. Some suggested practices reappear in slightly different form at different stages. This recurrence revals the persistence and fundamental importance of a small set of management functions. Communications, for instance, is one function that is needed continually.

What physical characteristics are needed to affect crowd behavior in favorable ways? The participants reported what the NBS staff found earlier: No systematic guidance is at hand. But the designers and managers went further: guidance should be formulated. The IAAM proposal described in Chapter Four will likely address this issue. Moreover, some Workshop observers

TABLE 2: SUGGESTIONS FOR MANAGEMENT

PREPARE FOR EVENT: Most problems can be anticipated and many of them averted with thorough advance work

- o Valuable information is available from facilities managers at previous stops on a touring group's itinerary.
- o Obtain and use demographic information relevant to the event, provided by local police, and records of past experience in the host city.
- o Management and security personnel should be prepared/able to guide and assist occupants through emergency egress procedures.
- o Security guards should be large and visible.
- o Provide uniformed ushers and security personnel.
- o Control arrival times by publicizing door-opening times in advance.

MANAGEMENT OUTSIDE: Crowd management begins long before the building is entered.

- o Provide public address information outside to keep waiting crowds advised and entertained.

Table 2 (continued)

- o Avoid undue concentration of people in any enclosed area.

- o Avoid large "bulk" queues, use smaller, easier to manage groups.

MANAGEMENT OF INGRESS: Control of Access is more than keeping out "gate crashers".

- o Do not admit cans and bottles.

- o For some types of events, conduct airport-style security checks on each entrant.

- o Intercept and isolate patrons, contraband and incidents that might stimulate adverse crowd behavior. Do this as far away from entrance as possible.

MANAGEMENT OF THE ASSEMBLY: At this point, management needs only to maintain stability.

- o Provide public address information capability throughout event. Authoritative voice communication is important in emergencies.

- o Public address system should never call attention to a scene of disturbance; rather, it should be used to divert attention away from the disturbance.

felt that the model for organizing crowd movement research presented under the research recommendations in Chapter Four will be helpful in organizing a design guide in the future. The assembled experts did recount some "do's and don'ts" for facilities designers. These are summarized in Table 3 and illustrated in the accompanying examples.* Table 3 is organized as a spatial progression of the kind routinely encountered when locating, entering and being seated at a large scale public event.

The suggestions in Tables 2 and 3 are presented to the extent possible in the performance oriented language. The performance approach allows maximum freedom in choosing the specific management practice or physical form to accomplish the intended result. This freedom, of course, is the main advantage of using performance criteria instead of prescriptive requirements, often accompanied by dimensional requirements.[19] But writing a complete performance criterion is exceedingly difficult because stating a policy's or a design's essential function completely, clearly, correctly and consisely is an intellectually demanding task. The writer of a performance criterion is soon at the limit of knowledge: knowledge of the function to be performed, designation of an accurate measure for assuring that the function has indeed been performed and a practice in precise method for making that measurement. When a practical matter like choosing a certain facility management practice or one physical form over another is taken to the limit of knowledge, the manager or designer must turn to the researchers for further guidance. This is the course the Workshop took as well. Consequently, this report's concluding chapter will take up the matter of defining a research strategy suited to provide better design and management practices.

TABLE 3: SUGGESTIONS FOR DESIGN

SITE PLANNING: Attention to buildings' environs should support effective crowd management practices.

- o Provide well-spaced peripheral entrances.
- o Provide a "first-rate" outside PA system to advise arriving patrons.
- o Provide effective links between the facility, parking, and public transit.
- o Provide special peripheral facilities for handicapped patrons.
- o Color-coded parking areas permit keying with color-coded tickets.

STAGING AREAS: Forecourts and vestibules have been significant elements of buildings throughout history; they have a vitally important function in modern places of public assembly.

- o Provide sheltered/weatherized preassembly facilities.

Table 3 (continued)

- o Key staging sub areas to specific doors.

- o Provide a "first rate" outside PA system to advise waiting patrons.

ENTRANCES: The physical design of the entrance itself needs thorough consideration because it can perform several functions.

- o Prevent preassembly/congregating at the entrance itself.

- o Door design should facilitate ingress.

- o Provide well-spaced peripheral entrances.

- o Separate ticketing from admissions.

- o Clearly distinguish ingress doors from egress doors.

- o Color-coded entrances permit keying with color-coded tickets.

Table 3 (continued)

CIRCULATION PATHS: Long-acknowledged as a generator of architectural form, circulation planning is equally potent as a molder of crowd behavior.

- o Strive for design simplicity in all access and movement routes: this lessens the need for directional graphics and ushers.

- o Provide for thru-ticketing only (no reversal of flow should be possible).

- o Capacity-handling channels should be continuous walking surfaces such as ramps. Stairs are satisfactory for shortening channels not subject to heavy pedestrian loads.

- o Stairs should be free of mechanical crowd-control devices . . . although they may themselves serve to control or meter crowd flow.

- o To the greatest extent possible, ingress system should be "reversible", and usable whenever emergency egress is necessary.

- o Designs for orientation: e.g., color coordination; redundant cues, etc.

Table 3 (continued)

SEATING AREA: The ingress job is not over until the patrons have arrived at their designated seats.

- Strive for design simplicity: this lessens the need for directional graphics and ushers.

- Provide a "first-rate" inside PA system to advise already seated patrons.

- Color-coded seating quadrants permit keying with color-coded tickets.

4.0 WHERE TO NEXT - SHARING BEST PRACTICES AND INITIATING RESEARCH

The design and management of places of assembly are practical tasks requiring an understanding of how facilities and their operation affect the safety and convenience of patrons or users. Designers and managers develop this practical knowledge through experience. Consequently, practitioners who have had numerous and varied experiences are likely to be more qualified to apply their craft successfully.

If success in a practical endeavor results from having a broad and deep base of knowledge from which to make decisions, the quality of practice can readily be enhanced by the documentation and exchange of information by practitioners. The Workshop participants found helpful the Report of the Cincinnati Task Force, and the films, videotapes and still photos shown at the Workshop. Therefore, the individual experiences of those involved in the design and management of places of assembly need to be collected and made easily available for application by many.

The documentation and exchange of information can be accomplished by: 1) identifying the critical design and management parameters of crowd dynamics; 2) developing methods for synthesizing anecdotal and varying accounts of situations; 3) developing means for rapid and easily understood information dissemination; 4) involving designers, managers, and public regulatory and safety officials in periodic seminars and workshops aimed at further illustrating or explaining recent findings and advances; and 5) involving organizations such as the International Association of Auditorium Managers (IAAM) and the American Institute of Architects (AIA) in the documentation and dissemination of information.

The IAAM, whose 900 members manage most of the major public assembly facilities in the U.S. and nine other countries, has taken the first step toward implementing a systematic information exchange. In July 1980, the IAAM Board of Directors authorized the appointment of an ad hoc "IAAM Study Group on Crowd Behavior and Management". The Study Group's report, "Spectators and Safety: The Development of Standards for and Their Implementation by Facility Executives" serves as a prospectus for a three-year program. IAAM is now seeking public and private funds for the project.

The combined experiences of practice and research will be instrumental in developing general principles and will help make possible analytical modelling of crowd dynamics; both of these ultimately will contribute to better practice. Consider now analytic modelling as a research opportunity.

A number of specific recommendations for improving design and management practices for places of assembly were presented earlier in this report. The value of mechansims for documenting particular experiences and for exchanging such documentation among facilities managers and designers also was discussed. Equally important is the need to undertake a long range program of research aimed at developing accurate and useful models of crowd behavior phenomena. Briefly consider such a research program, noting both the present state-of-the-art as well as future technical challenges. In general, the following is based on Workshop discussions. The program described responds to ideas presented at the Workshop and the writers, in preparing it, draw on the relevant technical literature.

To start with, opinions and judgments of participating experts led to the general conclusion that perhaps as much as 90 percent of observed variations in crowd behavior (B) may be attributed to variation in three factors: crowd characteristics (C), facility design and layout (F), and management practices (M). In very general terms, we may refer to the relationship between these factors with the expression:

$$B = f(C,F,M).$$

The term "crowd behavior" (B) is a complex variable consisting of several interrelated phenomena. These include, but are not limited to, the physical characteristics of crowds and their movement (e.g. measures of flow rates through building spaces and density of people in a space), normal crowd dynamics (i.e. the normal processes by which crowds form, change, and dissolve), and triggering mechanisms that transform normal crowds into potentially hazardous mobs. Crowd characteristics (C) may, for any given event, be defined in terms of demographic data, total quantities of patrons, degrees of aggregation within an overall crowd, and such affective factors as the "mood" of the crowd. Facility design and layout (F) refers to a building's overall configuration, layout of circulation elements, links with transportation facilities and parking, and capacities of means of ingress and egress. Management practices (M) include decisions about staffing, communications, security, admissions, and furnishings, which may vary from one event to another.

Accordingly, if a facility manager or designer possessed an equation (or model) which accurately specified the relationship among these factors, then the professional could predict, reasonably closely, crowd behavior at a particular future event on the basis of anticipated crowd characteristics, facility design conditions, and management decisions.

For example, the manager of a facility is planning for a particular rock concert. The professional has estimated likely crowd characteristics based on previous experience. For this example, we will assume that there are no substantive modifications to the physical plant which can be cost-effectively accommodated. The manager wishes to know, with some degree of statistical reliability, how various management decisions might affect crowd behavior and, in addition, where tradeoffs are possible. The manager converts the predicted conditions to quantitative form, and then employs the model

$$B = f(C,F,M)$$

where f is an empirically verified function. If the value computed for B is within some predefined "acceptable" range, then the manager concludes that a good match between crowd, facility, and management has been found. If B is outside this range, then some changes are necessary. For example, the manager may wish to reduce expenses by using fewer uniformed ushers. If this produces an unacceptable crowd behavior prediction (B in this model), then the manager might try altering the admissions policy in some way, in the hope that this will counterbalance the potentially negative effect of a reduced staff. The model would be employed again to test this modification, and the process repeated until the manager has a satisfactory plan.

This scenario is, of course, hypothetical. At present: (1) no equations exist specifying relationships between B, C, F, and M, and (2) neither standardized definitions of variables to be measured in the field, nor standardized methods for reliably measuring these variables are available. However, the objectives of the Workshop were not intended to focus specifically on model building and problems of measurement and data collection. The challenge for future research, then, is to develop useful and accurate

means for predicting normal crowd behavior, and for enabling facility managers and designers to evaluate various scenarios before costly mistakes are made. Predicting non-normal crowd behavior lies much further in the future and is beyond the scope of this discussion.

What knowledge is presently available and applicable to meeting these challenges? How far are we from valid and useful predictive models of crowd behavior in places of assembly? At present, a sizeable data base exists describing pedestrian movement in buildings[5, 10, 11, 13, 16]. By far the most pertinent and potentially the most useful data describing crowd dynamics in stadia and other places of assembly, however, have been collected by J. L. Pauls of the National Research Council of Canada's Division of Building Research (NRCC/DBR). Although many of Pauls' data have not been fully analyzed to date, and have been neither widely published nor circulated, it is becoming increasingly clear that numerous questions regarding interactions between crowd characteristics, facility design, and management practice may be analyzed using techniques and data developed by Pauls and his associates. A review of the Canadian Government studies is Appendix F of this report.

But while such data are becoming available, a search of the literature revealed no quantitative models that reliably predict crowd behavior. To make the leap from raw data to predictive models will require intensive analyses of crowd data to determine what factors are indeed operating, and to what degree each factor contributes to overall variance in crowd observations. This Chapter suggested earlier that, in the most general terms, the three factors, crowd characteristics, facility design, and management practice, taken together, may account for most of such variance. But even this hypothesis needs to be tested empirically.

Once general factors have been statistically identified, it will be necessary to describe particular instances within each factor mathematically in terms which allow interval comparisons. For example, it will be necessary to score discrete floorplans, management decisions, and sets of crowd characteristics along some interval scale (e.g., 0,1,2,3,4 . . . n), and to demonstrate that, for example, a floor plan scored "4" is "twice as good" as one scored "2. There presently exist no rational and standardized methods for performing such nominal-to-interval data conversions, and considerable advice from expert facility designers and managers will be required to assign appropriate numerical values to design and management practices. Only when factors have been identified and instances within each factor are rendered capable of numerical scoring can such statistical techniques as multiple regression analysis be called upon to synthesize predictive equations, or models. Finally, it will be necessary to test the validity and usefulness of such models under varying field conditions. Only through testing and refinement by qualified professions will it be possible to understand how best to use these tools.

Given the state-of-the-art, researchers believe it is possible to develop initial models within the next three to five years, and to make available properly tested predictive tools within the next ten years. A similar model, while directd chiefly to the unique problems of emergency escape from fires, has already been developed and partially validated.[14] To attain these goals will require the scientific and technical efforts of a skilled environmental psychology/human factors group, assisted by modeling experts, facilities

managers and designers. Between 50 and 100 person-years may be required. Finally, we believe that the conduct of this research by specially trained and equipped behavioral scientists, working closely with experts in the fields of facility design and management, and using observations of actual situations, will result in design and management methods which decrease the odds of unstable crowd behavior such as that which claimed 11 lives at the Cincinnati Riverfront Coliseum.

The research program required as a basis for improved quantitative design and evaluation procedures for crowd ingress exceeds the technical capabilities and financial resources of any single research group known to the writers. Certainly the National Bureau of Standards does not have the necessary skills. But the technical capabilities can be mobilized in university, private and government laboratories if resources are made available for a sustained program of research.

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APPENDIX A

WORKSHOP AGENDA

Law Enforcement Assistance Administration/National Engineering Laboratory

Workshop on

CROWD INGRESS TO PLACES OF ASSEMBLY

National Bureau of Standards
Lecture Room B

May 4, 1981

Sunday, May 3

6:00 p.m. Informal no-host gathering

Holiday, Inn, Gaithersburg, Maryland

Monday, May 4

9:00 a.m. Welcome to NBS

Dr. John W. Lyons
Director, National Engineering Laboratory

Mr. George Bohlinger, Acting Administrator
Law Enforcement Assistance Administration
U.S. Department of Justice

9:20 a.m. Statement of Workshop Charge

Dr. Richard N. Wright
Director, Center for Building Technology
National Engineering Laboratory

- o Identify best current design practices and performance criteria
- o Identify best current facilities management practices
- o Define research needs to support improved design and management

9:30 a.m. Morning Session

Problems of Crowd Ingress to Places of Assembly, and the Role of Facilities Design and Management Practice

- o Overview of Problems of Crowd Ingress to Places of Assembly

  Brief position statements by participating technical experts

- o How Do Crowds Enter Places of Assembly?

  Focused round-table to consider individual cases (Cincinnati Riverfront Coliseum; Toronto CNE Stadium) and to reflect on the role of facility design, facility management, and crowd dynamics (refer to Attachments 2, 3 and 4)

- How Do the Physical Characteristics of Places of Assembly Affect Crowd Ingress, Capacity, and Performance Under "Overload" Conditions?

  Round-table discussion to identify the role of physical characteristics and gaps in the current knowledge base

12:30 p.m. LUNCH

1:30 p.m. Afternoon Session

Implementing the Workshop Recommendations--who, when, where, how?

- Overview of the building regulatory process by Dr. Francis T. Ventre, Chief, Environmental Design Research Division

Feasible Approaches to Resolving Problems of Crowd Ingress to Places of Assembly; and Implementing the Recommendations

- How Can Designers Deal Effectively with the Problems of Crowd Ingress?

  Focused round-table discussion

- How Can Facility Managers Deal Effectively with the Problems of Crowd Ingress?

  Focused round-table discussion

- What Research is Required to Support the Design and Management of Places of Assembly?

  Focused round-table discussion (see Attachment 5)

3:45 p.m. Summary

4:00 p.m. Adjourn

APPENDIX B

ROSTER OF PARTICIPANTS

APPENDIX B
ROSTER OF PARTICIPANTS

LEAA/NEL WORKSHOP ON CROWD INGRESS TO PLACES OF ASSEMBLY

National Bureau of Standards
May 4, 1981

Dr. Randall W.A. Davidson
3550 Wilshire Blvd.
Los Angeles, CA 90010

(213) 385-5211

Mr. John DeMarco
General Services Administration
Office of Federal Protective
Service Management
18th & F Streets, NW
Washington, DC 20405
(202) 566-1063

John Graff
Council and Director of
Government Relations
International Association of
Amusement Parks and Attractions
Suite 330
1025 Vermont Avenue, NW
Washington, DC 20005

Charles Higginbotham
International Association of Chiefs
of Police
11 Firstfield Road
Gaithersburg, MD 20760

(301) 948-0922

Jack Lee, Fire Chief
Charlotte Fire Department
125 S. Davidson St.
Charlotte, NC 28202

President, International Association
of Fire Chiefs, Inc.
1329 18th Street, NW
Washington, DC

(704) 374-2791 (Office, Charlotte, NC)

Dr. John W. Lyons
Director
National Engineering Laboratory
National Bureau of Standards
Building 225, Room B119
Washington, DC 20234

(301) 921-3434

Thomas D. Minter
Lexington Center Corporation
430 West Vine Street
Lexington, KY 40507

(606) 233-4567

Mr. J.L. (Jake) Pauls
Division of Building Research
National Research Council of Canada
Ottawa, Ontario
K1A OR6
CANADA

Major Jack M. Sands
U.S. Park Police Special Forces
1100 Ohio Drive, SW
Washington, DC 20242

(202) 426-7943

Aaron Siegel
The Spectrum
Pattison Place
Philadelphia, PA 19148

(215) 389-9516

Dr. Robert Sigholtz
Starplex
2001 E. Capitol Street
Washington, DC 20003

Dr. Fred I. Stahl
National Bureau of Standards
Building 226, Room A355
Washington, DC 20234

(301) 921-3595

Mr. George E. Turner
National Bureau of Standards
Building 226, Room A355
Washington, DC 20234

(301) 921-2102

Dr. Francis T. Ventre
National Bureau of Standards
Building 226, Room B320
Washington, DC 20234

(301) 921-3704

Paul L. Wertheimer
City of Cincinnati
City Hall, Room 152
801 Plum Street
Cincinnati, OH 45238

(513) 352-3241

Talbott Wilson, FAIA
Talbott Wilson Associates, Inc.
2223 W. Loop South
#515A
Houston, TX 77027

(713) 626-0350

Dr. Richard N. Wright
Director, Center for Building Technology
National Bureau of Standards
Building 226, Room B250
Washington, DC 20234

(301) 921-3377

APPENDIX C

TECHNICAL PAPERS

RISK MANAGEMENT

FOR

PUBLIC ASSEMBLY GATHERINGS

Under the auspices of:

U.S. Department of Commerce
National Bureau of Standards
Law Enforcement Administration
National Engineering Laboratory

CROWD INGRESS TO PLACES OF ASSEMBLY

MAY 4, 1981
Gaithersburg, Maryland

HISTORICAL AND BEHAVIOUR PERSPECTIVES

By: Dr. Randall W. A. Davidson
Public Assembly & Entertainment Industry Consultant

HISTORICAL PERSPECTIVE

Ingress, the act of entering, cannot be considered without direct relationship to egress (the act of leaving or exiting). The confrontation of human beings with one another exists at all levels of human endeavour, and with confrontation comes violence. This violence can be visited upon other human beings and/or property. This violence can simmer and be insidious, or it can flare into external destruction.

History exacts upon us the behaviour we observe each day. It is not the "times", because the earth has always known violence. Ours is a history of this determined behaviour. Cain and Abel knew too well these stirrings of desire. The desire to gain territory through an opening, all have the gleanings of "ingress".

With these wants, desires and surfacing violence, we speed down from the historic paths, examining people and their desires and movements. The crowded courtyards, the ancient streets in older cities, the common baths, the churches, the stadiums, the battlegrounds, and the prisons. Too many people in one place, too many people in one cramped space, many people of common roots gathered in one ill-defined locale --and the list goes on.

I am in awe of the behaviour of humans gathered in open or closed spaces. St. Peter's Square in Rome, the stadiums in this country and South America, the bullrings, the convention halls, the parades, the rock shows, and just recently, the quarter of a million people of assorted ages, shapes and persuasions at the landing of the Space Shuttle.

Common Elements

The components of the crowd were all present: i.e., different behaviours, backgrounds, mores, ages and economic strata. But, the common behavioural note: The cause for gathering! (I might add, purpose does not reduce violence, at all levels. Have you been at St. Peter's Square in Rome for a religious event? Note the nuns; they move themselves, jockeying for position (seats) and would be the envy of any skatback or quarterback. We also note with sorrow, those who died, trampled to death in the human glut to see the Holy Father, John Paul II on his recent tour. The crowds were very large.

The crowd is many things. Those who are aggressive, always aggressive. There are those who come to watch, to observe, and to enjoy, quietly; there are the predators, whose behaviour at crowd scenes prey on the weak and the strong, jostling, pushing, striking out, and causing physical injury. The purpose in these instances sometimes weighs the event. The hockey games, the soccer riots, the rock shows, the after-the-game charge onto the field or game floor. The incidents are legion. Unfortunately, there seems to be a measured increase in the last 12 years, and an escalation.

Influences

Alcohol and drugs are specifically pointed to as both causes and means. Behaviour is altered for a myriad of reasons. This space, that seat, proximity to stars, being first, saving seats, a place in line, and other natural cravings. No longer do the old, familiar "patient" standards tie us down. We do not patiently wait in lines, anywhere, as we did during WW II, for our comforts (nylons, cigarettes) or for our needs (meat, bread, cheese, gas).

Present-Day Happenings

The mentality of the crowd has now become, in part, what it was nurtured to be, by events, a more common, animal drive.

Recall the Times Square crowds, the Mardi Gras Parade, the Grand Central Station servicemen groups, the Rose Bowl Parade & Game, and Soldiers' Field in Chicago. All of us recall Ebbets Field, which always seemed a tad rowdy. The Kentucky Derby seemed sedate by comparison. These places had some confusion, the thrust of human kind, but never did I see the level of viciousness that I see now. Even the gentleness of leaving church after the service has been vitiated by the rush to the parking lot.

Crowd Control

At what level of humanity and behaviour should we appropriately consider and actually apply control or order? History has supplied some controls in a few architectural and engineering ways. The vomitories in the old stadiums, the tremendously wide doors in the churches and public buildings. The stair cases were also wide and sweeping. The plazas generous and wide. Granted many streets were not as wide as we would have wanted, but there were wide, large avenues and streets.

Narrowing the Gap

We have physically encroached upon these generosities. Our mode of transportation is different, to the point, that we now crowd streets, freeways and bury our crowds into subways, trolleys, and buses. Crowds in our transportation, crowds in our housing, crowds in our places of worship, crowds in our educational institutions, crowds in our workplace, and crowds in our entertainment facilities.

Where do we go? Or better yet, how do we cope and adapt? We grow in a crowded environment which is hostile! The "me first" syndrome almost as if by synapse, is our daily fare. There are several directions to proceed, with all the "givens":

Suggested Avenues to Proceed

1. Recommendations for engineering and building standards;
2. Development of behavioural standards for crowd management;
3. Recommended instructions for all Managers, Administration and personnel who operate public assembly facilities;
4. Recommended guidelines to all associations, businesses and organizations who operate within the public assembly domain.
5. Specific recommendations to insurance, fire, and property personnel who deal with public assembly facilities.
6. Specific guidelines for educational institutions as related to conduct of students and personnel at all levels, and recommended courses of study and behavioural parameters.
7. Recommended guidelines to all architectural and engineering societies.
8. Recommended guidelines and standards for City Managers, Police, and County personnel who work with Public Assembly buildings and events.
9. Setting-up of a committee who will examine the needs of the next 25-50 years of construction of Public Assembly areas and buildings and how crowd management and strategies can be best utilized.

Observations

In the last 31 years we have visited thousands of open and closed structures, used especially for Public Assembly and for the Entertainment Industry. We have observed the individuals and the crowds in every part of the world. We finally arrive at the behavioural aspect of the

"crowd-minded". They, the crowd, may change. The awareness may be heightened as to their personal safety, by a variety of methods, but basically the emotion of the moment will hold sway. It is incumbent upon the shapers and the builders of our cities and architectural structures, the codes and standards committees, the managers of our political structures, to be cognizant and schooled in the vagaries of human nature, behaviours in crowded conditions, and mob volence.

They should also be carefully trained, instructed, and evaluated in those concepts and conceive elements which allow for psychological and physical crowd control. I am not suggesting drug control nor armed guards, but the necessary physical and behavioural strategies used to assure crowd control, or to control people- if a crowd becomes unruly or riotous. All these factors should be studied.

Guards & Security

Certainly guards may be used. They are and will be. Airports and their "check-point Charlies" it seems to me, have pointed the way toward every future public assembly gathering. We already have the technology of security with the surveillance cameras and TV monitors. This will, in fact, be our technology in a somewhat more sophisticated thrust, in all public assembly gatherings.

It seems we can depend upon the behaviourisms of large groups or crowds and therefore we should be able to plot the safety parameters which will safely control these behaviours.

Training

All personnel in public assembly positions should be well-trained in crowd management. The intent of this is all the more vital due to the

present poor training and qualifications of most security personnel. The uniform and adult ages are not now foremost deterrants of this day and age. There are systems in the U.S. for: Professional Training of security personnel. There are also institutes for the training of Personnel in the handling of terrorist activity. From a liability point of view, I believe this type of training would be beneficial, especially for key personnel in all public assembly situations.

The Reserve Corps recently finished a two-week course for officers, in the handling of terrorist activity. If one observes large race tracks where escalators are used, we observe a combination of technology and human energy. The escalators are set at specific speeds to move large numbers of people before the races and toward the end of the races. Guards are also stationed at the tops and the bottoms of the escalators, to insure control of the mass of people. The misstep of one person, however, can cause a pile up and panic.

Hotel and Nightclub Panic

Recall carefully the panic problems at the recent Night Club and Hotel fires. Here we have an external motivation for erratic behaviour based upon preservation of life. Specific safeguards had not been designed for these structures. Hardware, equipment, architectural structures, decorations, furniture, and windows... all of these had not been tailored for the specific function they had been designed for, i.e., the housing, movement, and entertainment of large groups of people. All aspects of human behaviour were engulfed in those major disasters.

Design

What we are receiving is a behavioural syndrome set by certain concepts of our civilization, i.e., the public buildings, places and

events are "Relatively" safe. We expect some crowds, some control, some jostling and some inconvenience. We also assume a level of trust when we move into the public sectior.

The architectural structure, guided by code, experience, and law, experiences another type of trust. What we know is that there is a dichotomy between the two trusts. The unit code for doorways may be observed, but we find it inadequate. Ingress may be relatively easily handled, if the structural parameters (space, width, etc) is carefully thought-out for the events which occur in each structure or public area.

Capacity

The facts often belie the design. Structures are always crowded beyond legal capacities. Structures, especially door units, hardware, surfaces, parking, aisles and corridors, strip units, balconies, staircases, and doors do not seem to be sufficiently and carefully designed to meet the actual needs - ingress or egress - of any crowd. Yes, the people move through, but the "adaptation" of the crowd is always depended upon. Adaption to the circumstances and to the structures. If the entrance units are not sufficient, then great energy and surge is used to push through.

Scraping, buffeting one another, bumping up against wall surfaces, and tripping, all the "usual" physical movements, propelled by a common behavioural drive. ME FIRST. Often times the movement through these spaces is promulgated by diverse movements, i.e., first come, first seated. (Festival seating). (Note the people who save seats, or who establish "territory".)

Those who do not want to move and are pushed, lifted and propelled along are trampled.

Directions

We proceed toward a number of givens in our pursuit of proper ingress:

1. Architectural parameters designed and coded, in order to mitigate any potential pressure cooker type of physical or space situation. Guidelines for renovation of existing structures (such as our rehab of buildings for handicapped), and Building Code modification for all new public structures, indoor and outdoor. All change should reflect actual performance synthesis, not archaic practices.

2. Specific procedures for ingress, egress and panic, should be spelled out with a technical eye toward potential crowd catastrophes. Every crowd situation should be observed, examined and plotted for individual control parameters, i.e., number of people, size of structure, space utilization, specific functions of area, and control factors.

3. Risk Management Control Procedures: Pre-planning for all situations must be initiated. element should be considered. Drills, such as in a disaster, should take place and be evaluated. Each control concept and management procedure should be systematically ordered, to mitigate each risk: i.e. guards, drills, planning, design, lighting, trained personnel,graphics, communication devices, etc.

4. Above all a major consideration should be understood:
   a. The use of Drugs, alcohol and terrorist tactics has shown an escalation in the last ten years.
   b. Those controls for ingress and management within these areas should be carefully planned, and developed. These contributing factors should be obvious, but often are misunderstood, or minimized.

5. The use of security technology should be encouraged, and a systems management program initiated.

6. Engineering data and behavioural studies have been published. The task is to add the present components and coalesce into one set of standards or guidelines. There are systems developed throughout the world which can be readily applied to this with meetings; the concensus of which can be combined into a definitive standard. The task is capable of being accomplished.

Crowd Disasters - A Systems Evaluation Of Causes and Countermeasures

By: John J. Fruin, Ph.D., P.E.
Research Engineer
The Port Authority of NY & NJ

Prepared for the Crowd Ingress Workshop sponsored by
The National Bureau of Standards and Law Enforcement
Administration - May 4, 1981

Crowding occurs normally in many human activities. High volumes of pedestrians, in the tens of thousands, are processed daily through transportation terminals, high rise buildings, stadia, and various types of public events. Efficient crowd management and control is a determinant of the quality of the human experience in these environmental settings, but more importantly, is a critical life safety consideration. There have been numerous crowd disasters, some of which are described in this paper, where uncontrolled crowding has resulted in significant casualties and loss of life. Many of these incidents could have been avoided by relatively simple crowd management and control strategies. An understanding of the system dynamics contributing to a crowd disaster is a necessary prerequisite to developing appropriate crowd management and control techniques. The systems analysis method is utilized in this paper to establish a framework for evaluating both the factors contributing to crowd disasters, and for suitable countermeasures.

The Crowd Disaster "System"

Systems analysis is a method of reducing an organism or pro-

cess to its simplest form for the purpose of developing an understanding of the elements comprising the system, and their contribution to its function. The fundamental systems analysis framework utilized in this paper has been successfully applied to many traffic processes, and is considered to be well adapted to a synthesis of the crowd disaster problem. Crowding disasters are viewed as a type of pedestrian traffic process in which certain critical performance limits have been exceeded.

Essentially, all systems are reduceable to four fundamental elements: (1) time, (2) space, (3) information and (4) energy.[1] The element of time is defined as the temporal period in which the system exists and performs, space as the physical setting in which it functions, information as the stimuli or communicative data necessary for the system to perform, or to modify its performance, and energy, the kinetic and potential mass energy required to sustain the system performance. For purposes of this discussion energy will be renamed the crowd force, and further defined as the energy created by massed pedestrians that results in crowd crushing pressures, and the injury and death associated with a crowd disaster.

The four fundamental crowd disaster elements are illustrated diagramatically on Figure 1. This diagram shows the crowd force as a vector or resultant of the other three elements. Units of time and space may be referred to directly in this discussion, i.e., minutes or square feet) or in combined units when expressed as a service rate such as persons processed per minute.

A definition of a crowd disaster is proposed on the basis of this system's outline and the supporting discussion that follows, namely:

> "A crowd disaster is the rapid coming together of a group of persons in a constricted space with sufficient mass and force to cause human injury or death."

The Element of Time

A review of crowd disasters shows that most developed in a relatively short time period, often within a few minutes, after a mass movement of pedestrians. Generally, there is a rapid accumulation or queue of pedestrians as the traffic processing or service rate of some element of the pedestrian circulation system is temporarily exceeded. As long as the demand or arrival rate is less than the processing rate of the element (stairs, corridors, doorways, escalators, elevators, etc.) pedestrian traffic moves freely. However, when the demand rate exceeds the processing rate of an individual element, even for a short period, the traffic flow process is interrupted, resulting in delay and queuing. Both demand (the arrival pattern) and service (processing capacity) are time related.

For example, arriving patrons are not subjected to the same delays and queuing at a stadium as departing patrons because the arrival traffic is typically spread out over a longer time period. The stadium departure demand is instantaneous, with almost all spectators desiring to exit immediately after the performance. A similar type of problem occurs in a transportation terminal when a large trainload of passengers is discharged onto a platform. In either case, the capacity of the pedestrian traffic system is temporarily exceeded, pedestrians are delayed and queues form. Platform clearance times of up to 9 minutes have been observed in New York's Pennsylvania Station after the simultaneous arrival of about 2,400 passengers in two trains at one platform, and clearance delays of 20-30 minutes are not uncommon for departing spectators at large stadia.

A simple crowd incident at the 1970 Japanese Exposition illus-

trates the factor of a rapid queue buildup. A pedestrian tripped and fell at the outlet end of a long mechanical walkway at the Exposition blocking the exit and causing a pileup of following pedestrians. The pileup resulted in injury to 42 persons, but none fatally (Appendix A1). Moving walk systems have a practical traffic capacity of about 100 persons per minute, indicating the entire incident occurred within a relatively short time before the walkway could be stopped. This incident and others to be discussed show that rapid queue buildup at an overloaded pedestrian processing facility of some type is a common crowd disaster characteristic.

The Element of Space

Another common characteristic of crowd disasters is the development of critical pedestrian densities, approaching the plan view area of the human body, or about 1.5 square feet area per person or less. At these personal area occupancies the pedestrian becomes incapable of individualized movement although surges, pulses, or other sporadic and uncontrolled group movements may occur. An illustration of crowd densities approaching the critical density level is shown as Figure 2. This photograph, which is the product of Otis Elevator Comapny studies of elevator capacity, shows average pedestrian areas of about 1.8 square feet per person.

The relationships of average personal areas to pedestrian traffic movement and individual personal mobility is reasonably understood.[2] Pedestrians moving in a traffic stream require average areas of 25 square feet per person or more to attain normal walking speeds and to bypass and avoid conflicts with others. As the average area is reduced, walking is slower and more restricted, with higher probabilities of conflict and inability to

CROWD DISASTER "SYSTEM"

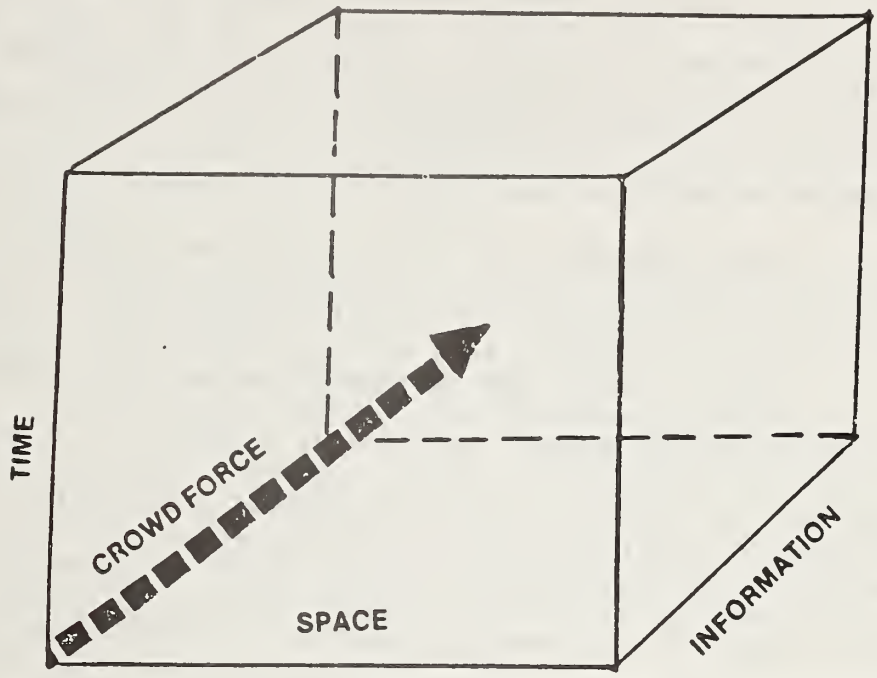
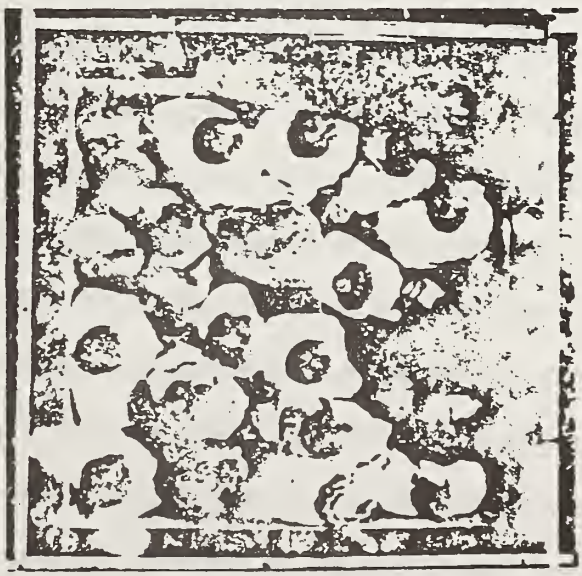


FIGURE 1

PEDESTRIAN AREA OCCUPANCY OF ELEVATORS



MIXED OCCUPANCY — APPROXIMATELY
1.8 SF/PERSON

FIGURE 2

bypass others. At ten square feet per person, walking becomes significantly restricted and speeds markedly reduced but some individual freedom of movement is retained. Surprisingly, the maximum capacity of a walkway is attained at approximately 5 square feet per person, with locomotion reduced to a shuffling gait, with movement generally possible only as a group, and with virtually no individual choice of direction. This would be characteristic of an exiting crowd from a stadium.

Below 5 square feet per person average area occupancy, individual pedestrian mobility becomes increasingly restricted. At approximately 3 square feet per person, involuntary touching and brushing against other pedestrians occurs, a behavioral threshold which is generally avoided in public, except in more crowded elevators or transit vehicles. Below 2 square feet per person, potentially dangerous crowd forces and psychological pressures begin to develop.

The gradual development of critical pedestrian densities resulting in potentially dangerous crowd forces can be illustrated by a personal experience of the author. The incident occurred in Pennsylvania Station, New York, when a general delay in commuter train arrivals created a large temporary and growing accumulation of standing pedestrians in a confined passenger waiting area of about 8-10,000 square feet. The crowd gradually reached a critical density at which personal individual movement was impossible. Unusual "shock waves" ran through the closely packed crowd, at times creating the sensation that the crowd was a single pulsating and uncontrollable mass. These shock waves were mostly caused by pedestrians entering the crowd mass from an escalator and stair group. The shock wave was magnified as it moved through the crowd resulting in a force sufficient to cause surges or lateral uncontrolled crowd movements

of about 8-10 feet, approximately 100 feet from the source. Much fear ran through the crowd, with many persons urging each other to be calm and not to push. Station security personnel were unable to control the situation, until crowd densities were finally reduced by loading several late arriving trains.

A recent press report describes a similar incident that occurred on a Bay Area Rapid Transit (BART) system platform after an interruption of train service. A large crowd accumulation developed on the platform, aggravated by the continuous passenger delivery characteristic of an escalator, which kept bringing pedestrians into the confined platform space. Fortunately, a potentially serious incident was avoided by stopping the escalator (Appendix A1).

The Element of Information

The mechanical walkway crowd incident at the 1970 Japanese Exposition was notable in that information was not involved in producing the crowd motivation that resulted in the pileup of pedestrians. The crowd force creating the incident was produced by the mechanical walkway itself. In the author's personal experience in Pennsylvania Station, critical crowd densities were reached, but positive communication by the unwilling participants in the crush helped to avoid potential disaster.

The information communicated to and within a crowd viewed as perhaps the most significant factor in developing the group motivation and crowd forces necessary to produce a disaster. Two general group behavior categories have been defined by psychologists as operable in crowd disasters: (1) panics, and (2) crazes[3]. Panics are almost always associated with crowd egress, whereas crazes with crowd ingress disasters.

Panic - A panic is defined as a group behavior involving flight from a real or perceived threat in which personal escape appears to be the only effective response, and where the group behavioral structure deteriorates because the escape route is perceived to be inadequate to accommodate the group. It should be emphasized that the initial flight from a source of danger is a normal human reaction, and that the panic behavior is a resultant of a frustration of that escape. The disintegration of the group behavior may result in impulsive choices of individual escape tactics without regard to realities of the surrounding environment, or reasonable concerns for personal safety and the safety of others. The role of information in panic situations can be illustrated by two classical crowd disasters involving a group perception of a threat, when in fact no substantial threat existed other than that from the uncontrolled group action itself.

The first is the Brooklyn Bridge panic on Decoration Day, May 30, 1883, six days after the bridge opened. The day was warm and sunny and an estimated 20,000 pedestrians were walking across the bridge. The incident began at a staircase at the Manhattan end of the bridge which became jammed with pedestrians moving both up and down. Oncoming throngs from both directions kept shoving those who were immobile on the steps. A woman lost her footing on the steps, falling on those beneath her, and causing others to fall. The excitement and cries of the injured attracted others, and in the confusion, some shouted that the "bridge was falling". This incited the crowd into a movement to escape and in the resultant crush 12 persons were killed and scores were injured (Appendix A2).

The other famous case of group panic is Iroquois Theater fire of 1903, when in an 8-minute period 500 patrons perished, mostly in crowd crushes at stairways and inadequate exits. In this incident someone ob-

served smoke and loudly yelled "fire", causing a spontaneous mass exodus. The actual fire damaged only a few seats in the auditorium and probably was never a serious life safety threat to the audience. The theater was back in business after a few days.[4] The Iroquois Theater disaster may have prompted the famous quotation by Supreme Court Justice Oliver Wendall Holmes, "The most stringent protection of free speech would not protect a man in falsely shouting 'fire' in a theater and causing a panic." (U.S. Supreme Court, March 3, 1919, Schenck vs. United Stated). A judicial recognition of the relationship of the information element in group behavior.

Crazes - A craze is defined as a group behavior in which there is a temporary short lived competitive rush by a group toward some attraction or objective considered to have some important human or material value. The normal group behavioral structure disintegrates into a temporary abandonment of established personal values caused by a complete short-term fixation on the objective. Information is involved in a craze by creating, or disproportionately enhancing the attractive value of the objective to the group member, or as shown in the panic examples, by inciting the group to action by false information relating to the attainment of, or access to, the objective.

Two crowd disaster incidents occurring during the 1980 world tour of the Pope and the December 3, 1979, Cincinnati Coliseum disaster are illustrative of a group craze (Appendix A3, A4). During the Pope's May visit to Kinshasa, Zaire, seven women and two children were trampled to death and 72 persons were injured trying to get into an open-air Mass. A crowd waiting to attend the Mass surged toward an iron gate when it was opened for their entry. In Fortaleza, Brazil, in October, a crowd crush killed seven and injured dozens more when thousands of persons

broke down the gates to obtain choice seats in the Castelao Stadium seven hours before the Pope's arrival. Later on in the day, the Pope addressed an overflow crowd of about 140,000 without reported incident. The behavioral craze in the Cincinnatti Coliseum incident in which 11 died, was also created by a desire to obtain choice seating, coupled with limited ingress capacity.

Movement and Crowd Forces

The combined pressures of massed pedestrians and shock wave effects through crowds at the critical density level produce forces which are impossible for individuals, or even small groups of individuals to resist. Reports of persons being literally lifted out of their shoes and of clothes being torn off are a common result of the forces involved in crowd incidents. Survivors of crowd disasters report difficulty in breathing due to crowd pressures, and asphyxia is a more typical cause of deaths than trampling by the crowd. In the Glasgow Scotland soccer stadium incident in which 66 persons died, the failure of a steel railing under crowd pressures contributed to the piling up of pedestrians (Appendix A4). The bending of a steel pipe railing under crowd pressures was reported at the Cincinnatti Coliseum incident. The force required to bend a 2" diameter steel railing, applied 30 inches above the base is estimated at 1100 pounds (Appendix A9).

The extreme crowd pressures generated in crowd disasters require pushing within the crowd to produce the momentum that results in the compounding and magnification of forces. When the crowd is densely packed and forces are applied it performs as an almost incompressible fluid medium, with shock waves moving through it. In a densely packed but static crowd there would be discomfort but no extreme crowd

force. However, a dense crowd has the potential for shock wave propagation at any time.

Countermeasures

The system elements of time, space, information and energy provide a framework for developing countermeasure strategies for reducing the probability of crowd disasters where there are large public gatherings.

The objective of time based crowd management strategies is to prevent the buildup of large pedestrian queues in short time periods. This requires the provision of adequate pedestrian processing facilities and processing personnel to accommodate expected patterns of pedestrian demand. The demand pattern should be managed where possible to establish a consistent pedestrian arrival process. A simple example of time management of demand is the printed time of arrival ticket used for special exhibits. In places of assembly, early arrivals should be accommodated and not accumulated into a large queue.

The objective of space based crowd management is to prevent the rapid buildup of large pedestrian queues in limited or constricted spaces, and/or processing through inadequate pedestrian facilities. Virtually all crowd disasters have occurred at some form of bottleneck or traffic flow constriction, such as an inadequate stair or entrance/exit portal. Dispersion of ingress and egress at public gatherings through separated access points is a good example of a spacial crowd management strategy.

Demand metering is a time and space crowd management strategy which can be used effectively to prevent queue buildups at critical processing elements. Metering is the control or holding back of pedestrians at a processing element, releasing them at a rate equal or less than the service capacity of the element. Metering must be exercised with caution,

because it also produces a queue, but ideally in a better crowd control configuration. An example of a meter would be the development of a pedestrian holding area away from the head of a stair to prevent potentially dangerous crowding and pushing at the stair interface. The meter helps to absorb surges in demand, keeping the arrival rate in balance with available capacity.

The objective of information based crowd management strategies is to modify the time and space elements to prevent large pedestrian accumulations, and where possible to prevent the onset of a behavioral panic or craze. A printed ticket stipulating both time of arrival and dispersed point of ingress is an example of the use of information media for crowd management. Reserved seating, as opposed to general admission seating, reduces the possibility of a behavioral craze. Visually well defined and adequately designed pedestrian facilities, in the direct line of probable human flight, tend to limit potential panic.

The objective energy or crowd force management strategies would be to prevent the development of rapid mass movements of pedestrians in public gatherings. This involves all the foregoing strategies of time, space and information management. Crowd forces can be minimized by separating waiting pedestrians into smaller groups, avoiding sudden crowd disturbances, or the rapid opening of an undercapacity processing element in the face of a large crowd accumulation.

CROWD DISASTERS - SYSTEMS EVALUATION

SUMMARY TABLE

SYSTEM ELEMENT	CAUSES/CHARACTERISTICS	COUNTERMEASURES
TIME	Immediate pedestrian demand exceeding processing facility and/or processing personnel capacity, rapid accumulation, queue buildup.	• Temporal dispersion of demand; • Provision of processing elements/ personnel ≥ demand & allowances for variations; • Demand metering under close controls.
SPACE	Space limited, traffic flow constricted (bottleneck) average individual personal area occupancies below 2 square feet, approaching area of human body.	• Spacial dispersion of traffic flow, multiple portals for ingress, egress, space configuration; • Adequate traffic flow capacity and queuing space.
INFORMATION	Information provides crowd movement and direction, momentum; may induce behavioral panic or craze.	• Information for spacial and temporal dispersion through ticketing, signs, announcements; • Avoidance of group competition producing behavioral panic, craze; • Crowd management communications.
CROWD FORCE	Crowd mass approaches characteristics of fluid, shock wave affects, crowd pressures sufficient to cause human injury.	• All countermeasures above; • Prevention of rapid crowd movement; to reduce momentum, shock wave affects.

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San Francisco Chronicle Fri., Nov. 14, 1980

Shockwave From S.F. Mishap

Huge Jam on BART Escalator

Thousands of BART commuters had an awful morning yesterday after a disabled train in San Francisco caused a bizarre foulup miles away at the 12th Street station in Oakland.

Commuters were delayed about a half hour, and many wound up running in place on a jampacked escalator.

About 8 a.m., a train bound from San Francisco to Concord developed problems near the Embarcadero Station. Because of a malfunction with the propulsion system, the train wouldn't go forward.

The operator got permission from BART central control to back the train through a switch onto the westbound tracks at the Embarcadero.

Meanwhile two 10-car trains full of commuters were zipping along, headed for San Francisco. One had come from Concord and was at 12th Street in Oakland. Rather than send the train down the track that was blocked by the stalled train in San Francisco, BART decided to send it to Fremont instead — bad news for about 700 passengers who wanted to go to San Francisco. Everybody got off.

Then central control heard that the stalled train had moved out of the way and that the San Francisco track was clear again, so it decided to send the Oakland train to San Francisco after all. But somebody forgot to open the doors, so the train left the station with its ex-passengers still milling around the 12th Street station platform.

Just then, the Fremont-to-San Francisco train pulled in on the track upstairs, with another 1000 annoyed passengers. These people had planned to ride to San Francisco, but BART had diverted their train to Richmond. So they piled off at the 12th Street station and headed downstairs to the platform where the San Francisco trains come in.

That platform was jammed with refugees from the earlier train and could hold no more people. Passengers heading down the escalator couldn't find any room to stand, and there were so many people behind them they couldn't go back, so they stayed on the escalator. But the escalator steps kept moving — and with no place to go, the passengers had to run in place, as if they were on a treadmill.

After several minutes of this, the passengers set up such an outcry that the station agent finally shut off the escalator.

"It sounds amusing," said one of the passengers, "but it came close to a panic. There was just nowhere to go and that damned escalator wouldn't stop."

"It was a very unfortunate situation," said BART spokesman Sy Mouber. "It was one of those mornings."

The incident delayed trains about half an hour.

Expo Sidewalk Moves Again

OSAKA, Japan, April 4 (UPI) —The moving sidewalk at expo '70 began moving again Friday after a shutdown of eight days following an accident that injured 42 persons after a woman fell. Officials said 28 hostesses and 28 guards had been added to the regular staff that patrols the sidewalk.

Sunday N.Y. Times
4/6/70

PROBLEM LINE

By Anita Richterman

Q. We would like to know about the panic on the Brooklyn Bridge, in which several people were killed. Is it true that it was caused because someone said the bridge was falling? When did it take place, how many were killed, and why did anyone think it was falling?

—4th Grade, Daly School, Port Washington

A. The tragedy occurred on May 30, 1883, six days after the bridge was opened. It was Decoration Day; the afternoon was warm and sunny and an estimated 20,000 people were walking across the bridge at 4 PM, the approximate time of the incident. The panic began at a staircase leading to the promenade at the end of the Manhattan approach. As people tried to walk up the stairs, others were coming down, creating a massive traffic jam. Oncoming throngs from both directions kept shoving against those who were immobile on the steps. One woman at the head of the stairs lost her footing and was pushed onto those below her, causing others to fall. The stairwell was packed with dead and dying victims and many people had their clothes torn off. The excitement and cries brought more onlookers who contributed to the devastation. People were so jammed that many had blood oozing from their noses and mouths. Those who couldn't see what was going on said that the bridge was falling. By the time it was over, 12 persons had been killed and scores were injured. Some theorized that the panic had been started by pickpockets, who would find easy targets among the terror-stricken victims.

Six Trampled to Death Before Papal Mass

Combined News Services

Fortaleza, Brazil—Crowds rushing into a stadium to see Pope John Paul II trampled six people to death yesterday and another died of a heart attack, officials said. The tragedy, in which dozens were injured, recalled one that marred the Papal visit to Zaire in May. Yesterday's incident occurred seven hours before the Pope's arrival.

A Vatican spokesman said the Pontiff was informed of the tragedy when he flew into Fortaleza, capital of the state of Ceara on the Atlantic, from Belem, at the mouth of the Amazon. But the Pope, on the 10th day of his 12-day visit to Brazil, made no direct reference to the deaths when he came to Castelao Stadium and an overflow crowd of about 140,000.

"It was about 3:30 AM and the street was swarming with people outside the stadium chanting, 'We want to see the Pope,'" said the spokesman, Paulo Viana, who was standing in a cafe across the street.

Gen. Assis Bezerra, the Ceara state security chief, said that thousands of people broke down the main stadium entrance and rushed for the best seats.

During the Pope's visit to Kinshasa, Zaire, seven women and two children were trampled to death and 72 were injured trying to get into an open-air mass. The crush occurred as the iron gates of the People's Palace were opened at dawn for the service on the concrete steps.

At the stadium mass, John Paul praised Fortaleza residents "for your proverbial courage . . . and your intrepid attitude in the struggle for survival, which is worsened by the inclemency of nature and the bitterness of the climate."

Today, John Paul opens a key congress of the nation's bishops devoted to Brazil's vexing problem of peasants drifting from the land to the cities. "Each city I visit will be one more step on the road to this final goal," the Pope said in speaking about his opening of the 10th National Eucharistic Congress.

Church sources said the Pope might bring up the question at the conference of achieving social justice through peace or revolution. The issue has been a major theme of John Paul's first nine days in Brazil.

Crowd Crush Kills 11, Injures 8 At Rock Music Concert in Ohio

Combined News Services

Cincinnati—Eleven persons died last night and eight were seriously injured in the crush of a crowd trying to get into Riverfront Coliseum for a rock music concert by The Who.

"The crowd must have jammed the people up so tightly in front that they just passed out," Police Officer Dave Grawe told the Cincinnati Enquirer. "They didn't even fall down. They must have jammed up so tight that they didn't get any air and just died."

Jim Holmstrom, 28, of Cincinnati, was standing in the front of the crowd with his brother, Dave, 22. "I thought I was dead," he said. "I can't stop shaking. I think my brother is dead. He was next to me and went down in the rush. I don't know how I got out. Somebody was on top of me. I couldn't breathe . . . It was a real nightmare."

Jeff Manchester, 22, of Sidney, Ohio, said the crowd started gathering about 1:30 PM. He said that when the doors finally opened for general admission seats, there was a mad rush.

"I was grabbing for hair. I was grabbing for bodies. I was grabbing for my life." he said. "I knew some of the people under me were dying. But I could not get up."

Ray Schuerman, an usher at the main gate, said the trouble appeared to start when someone threw a bottle at the gate and broke the door's glass. "The kids kept breaking the gate more and more," he said. "I just couldn't stop them. They rushed the gate."

The 18,000-seat coliseum was sold out for the event, and there were reports that only one or two doors were opened for the crowd.

"A lot of young people apparently had been out there a long time before the doors opened," said Mayor J. Kenneth Blackwell. "They were cold. Some were drinking alcohol, some were smoking marijuana, and when the doors opened, all sense of rationality left the group."

The area in front of the coliseum was strewn with broken bottles as medical personnel worked on the victims. "We have all sorts of life-saving devices," said a paramedic. "We have drugs. We have highly trained people, and none of it did a bit of good. They just died. We couldn't save a one of them."

Doctors at one of four hospitals to which victims were taken said the deaths and injuries were not drug-related, but they could not confirm how many had died of suffocation or trampling. The dead were seven men and four women between the ages of 18 and 22. Their names were not immediately released.

Dr. Alex Trott, emergency room supervisor at Cincinnati General Hospital, said the victims suffered multiple bruises, and "there was some evidence of footprint-like injuries."

Jeff Chaney, an Army veteran and a student at Miami (Ohio) University, said he tried to save three of the victims by mouth-to-mouth resuscitation, failing "because people just didn't seem to care." He said one woman was alive and clutching his leg as he tried to unsort the pile of people, but died before she could be freed. The concertgoers, he said, "could see the people all piled up, and they still tried to climb over them just to get up front."

A nurse who witnessed the crush said, "Some made it; some didn't. Several died within two or three minutes. The whole occurrence took no more than 40 minutes. It's a real sad way to go."

While authorities coped with the crush outside the coliseum, the concert went ahead as scheduled, with most of those already inside unaware of what had happened. Cincinnati safety director Richard Castellini said the rush on the door occurred because some seats for the concert were reserved while others were on a first-come, first-served basis. He said he would seek an ordinance to require that only reserved seats be sold to such concerts in the future.

Castellini said he considered cancelling the concert, but let it go on because the problem existed only outside the hall. Blackwell said authorities feared there would be a riot inside the coliseum if the concert were called off.

The Who, one of the most durable of the early-'60s British rock groups, is featured in the recently released film, "Quadrophenia." The group wrote the rock opera "Tommy," which also became a movie.

Those who heard the concert blinked in the glare of television lights as they filed out of the coliseum after it was over. "What's going on?" they asked reporters converging on them. "Was anyone hurt?"

Newsday Dec 4, 1979

After Britain's worst sports disaster:

Mourning Scots check dead

GLASGOW, Scotland — (UPI- Reuter-CP) — Mourning Scotsmen yesterday identified the bodies of relatives among the 66 persons who died Saturday in the worst disaster in Britain's spectator sports history. Three of the dead remained unclaimed more than 24 hours after being trampled or suffocated under a massive pile-up of soccer fans at Glasgow's Ibrox park.

Two of the dead were a Canadian father and son, identified as David MacPherson, 30, of Edmonton, and his eight-year-old son, Nigel. They had been on holiday in Scotland, police said.

More than 200 other persons were injured, 66 seriously enough to remain hospitalized.

As the shocked nation mourned for the dead, British Sports Minister Elton Griffiths summoned top advisers to discuss safety provisions for spectators in soccer and other sports stadiums. Police assembling details of Saturday's tragedy reported many witnesses said it began when fans filing out about a minute before the end of the cliff-hanger Rangers-Celtic match dashed back up the stairs.

Their signal was a roar indicating the Rangers had scored a last-second goal to tie Celtic 1-1. But the final whistle came as they still headed onwards and hundreds of other fans began swarming down.

The witnesses said the massive weight of the two straining throngs snapped a gray, tubular steel railing — one of several running down the concrete stairs for handgripping and crowd channeling.

"HOUSE OF CARDS"

A small boy fell. Several adults tumbled. Suddenly, everyone was falling forward, the witness said.

The victims fell atop one another "like a collapsing house of cards," one survivor said. In about two minutes, 53 persons were dead. Police said 13 more died enroute to hospitals.

A policeman said he was leaving the match when he heard shouting and screaming.

"I looked back and saw a terrible sight," he said. "A pile of bodies about 10 feet high, all laid the same way, with their faces toward us — a wall of heads and faces."

"I carried away one ginger laddie and a colleague gave him the kiss of life (mouth-to-mouth resuscitation) until a doctor told him: 'Don't waste your time.'

"BUT HE WAS DEAD"

"I gave the kiss of life myself to a man I thought was alive. Twice I thought I had him breathing, but he was dead.

"The injuries of some of the people who had been crushed right under the barrier were terrible. We came away without boots, socks and the bottoms of our trousers soaked in blood.

"It was only possible to drag people clear from the top by linking hands so that, in reaching over, we didn't fall on top of them."

In the middle of the crush was Sam Smith, 19.

"I saw them fall," he said. "they were dropping like ninepins and the crowd behind kept forcing us on. I was still standing upright, being crushed as though in a vise, when I blacked out.

"I came to at the bottom of the stairs. I just lay there, watching the dead being dragged away."

"SIX BENEATH ME"

"I was coming up the passageway when the barrier broke," said Robert Campbell, a 36-year-old process server from central Scotland. "All of a sudden there were six men beneath me."

"I thought I was dead," he said. "People kept piling on top of me.

"I did not expect to get out alive. Then a police officer dragged me out from under the bodies," said Campbell, who suffered a crushed ankle.

John Allen is a slim, 24-year-old fan of the Rangers soccer team from Tillicoutry, Scotland. He had a leg injury and said, "It was hellish."

"I ended up under a pile of men. Some were dead. Men and boys were lying in one gigantic mass about 50 yards long in the passageway," he said.

TRIED TO COUNT

George Connor tried to count the bodies.

"I gave up when I got to 40. I just couldn't face it any longer."

"Everybody was pushing forward, but when they realized what was happening, they tried to fall back," said William Stevenson.

"Everything was confused. There were arms and legs sticking out all over the place. We saw a young girl about 18 who seemed in a bad way. We got her out of the fallen crowd but she was dead when we reached a dressing room."

The victims' shoes and jackets were often ripped off. There was only one way of identifying many — an anxious relative. By midday yesterday, a few still were unidentified.

"Has anyone seen my wee laddie?" a grandmother wept as police handed her a cup of tea.

One of the unidentified was a boy about 11, a blue and white Rangers scarf snug around his throat.

It was not her wee laddie. The tears still flowed.

"I think it was sheer popular excitement that caused this disaster," said Rangers' manager William Waddell.

"People were in a hurry to leave the match and then were in a hurry to get back again. The game was at such a state that either Celtic or Rangers could have won."

Sports Minister Griffiths summoned his two top advisers, Sir John Lang and Walter Winterbottom, to a meeting today in London to discuss the disaster's general implications.

Lang headed a committee which recently recommended a series of improvements British soccer clubs could make regarding hooliganism and crowd control at games.

But the Lord Provost of Glasgow, Donald Liddle, when asked if mandatory safety rules would have prevented the tragedy, said:

"I don't think they would. There was a human element here."

Liddle said, "One cannot prejudge the outcome of an inquiry, but it certainly does appear that the reason of the crowd surging back up the stairs is the most credible."

The annual Celtic-Rangers New Year's games have become one of the most exciting sporting events in Britain because of the rivalry between the two.

Police have often had to arrest as many as 100 people at matches between the two sides.

On Saturday, with a lack of goals for most of the game, police were congratulating themselves on a quiet and orderly game. Only two arrests had been made before tragedy struck.

Religious fervor enters into the rivalry. Celtic fans are mostly Roman Catholics of Irish origin. Rangers followers are Protestant.

Until a few years ago the match was played on Scotland's traditional New Year's day holiday. But authorities changed the date because felings — heightened by the effects of heavy whisky drinking — too often boiled over into a riot.

Britain's worst previous soccer disaster happened at Bolton in 1946 during a match with Stoke. The barrier collapsed there and 33 died and more than 500 were injured.

Toronto Globe/Mail Dec. 5, 1975

Two soccer fans die, many hurt after 21 stadium guardrail collapses

BUENOS AIRES (UPI) — A stadium guardrail collapsed under the strain of hundreds of soccer fans near here Wednesday night, causing the death of two of them.

One was crushed to death when about 100 persons fell 30 feet from the top of the stands. The second victim died of a heart attack and an undetermined number of persons were injured, police said.

Fans angered by the deaths tried to burn down the stadium, in La Plata, 35 miles southeast of Buenos Aires, but firemen quickly put out the flames.

The La Plata team scored the only goal with seven minutes left to play in a first-round match of the national playoffs.

Fans in the stands leaped to their feet and cheered. Witnesses said the crowded appeared to push up and back, fearing an avalanche of persons falling forward. The wooden guardrail at the top of the stands then gave way.

Ottawa Citizen May 3, 1977

120 hurt in arena fire, panic

MEXICO CITY (AP) — A cluster of hydrogen-filled balloons burst into flames Monday at a ceremony attended by President Jose Lopez Portillo and 120 children were injured.

Polie said some were burned and others were trampled in the panic to escape. Five of the youngsters were in critical condition.

Lopez Portillo, who was not injured, helped coordinate aid for the injured, who were taken to nearby hospitals.

He then suspended the opening ceremonies of the national cultural, artistic and sports competition.

One witness said he saw a person flip a cigarette at about 30 balloons bunched together and tied to a bicycle-track rail in the building.

He said that when the balloons exploded in flames many of the 3,000 children in the stadium fled for exits, some with their clothes afire.

Girl crushed by rock fans

TOKYO (AP) — A crowd of 2,000 screaming fans stampeded during a concert of the British rock band Rainbow in Sapporo Friday, crushing a 19-year old girl to death and injuring several other persons.

They said the crowd rushed at the stage shortly after the group began playing at the winter sports resort on the northern island of Hokkaido, 950 kilometres north of Tokyo.

One of the 150 guards posted in and around the sports centre where the concert was being held said that minutes after Rainbow began its performance, the mob of cheering fans made a rush for the stage.

"I saw some people about 17 to 18 rows from front topple over like dominoes and then I rushed in with other guards to help restore order," he said.

The GAZETTE, Montreal, Tues., Apr. 13, 1976

Faith healing session fatal for 21

RIO DE JANEIRO — (AP-UPI) — A melee touched off by a sermon on faith healing killed 21 Brazilians, including two children, and injured 29 others during a packed inaugural service at a Protestant church in suburban Neves, police said yesterday.

"I saw people being crushed to death," said Aimerinda Coelho, who was being treated for injuries at a first-aid hospital. She said the trouble began Sunday afternoon when several people started quarrelling.

"I fell, and people stepped on me, but fortunately, I had received the Grace of God and managed to escape," she said.

More than 2,000 persons crowded into the new building of the God is Love Church in the outskirts of the district of Sao Goncalo, a 40-minute drive from downtown Rio de Janeiro.

Officials said the preacher, David Martins de Miranda of Sao Paulo, was giving a sermon on the importance of faith healing and that part of the congregation started saying he was an impostor.

Police had said Sunday that the incident occurred in an old building and that a wall had collapsed, but yesterday they said their original information was incorrect.

Rev. de Miranda is said to be popular in the suburban districts of Rio de Janeiro and likes to refer to himself as "The envoy of the Messiah."

Witnesses disagreed on what set off the stampede. One woman said a female worshipper suddenly fell into a trance and the crowd backed away from her, knocking over their neighbors and spreading the panic.

Others said worshippers pushed forward when the fiery Miranda, who poses for promotional posters with mounds of discarded crutches, climbed to the church roof to speak because he could not reach the pulpit through the crowd.

THE NEW YORK TIMES, MONDAY, FEBRUARY 9, 1981

24 Greek Soccer Fans Die in Stampede After Match

Special to The New York Times

ATHENS, Feb. 8 — At least 24 Greek soccer fans were killed and dozens injured after being trampled on by other spectators trying to force their way out of a crowded stadium, the police said.

The police announcement said the stampede occurred at the end of the game between Olympiakos, the Greek first division champions, and an Athens team, as fans tried to leave the stadium but found the exit gates closed. The match was attended by a capacity crowd of 45,000.

The police announcement said the spectators at the front of the crowd were crushed between the corridor walls and exit gates, pushed by thousands of others trying to force their way through behind them.

Death Toll Expected to Rise

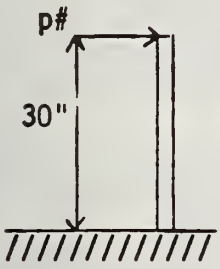
"When the gate eventually gave way," a police spokesman said, "the spectators fell and trampled each other to death." He said the death toll was expected to rise.

The police said most of the dead were believed to be supporters of Olympiakos, who in the excitement over their club's 6-to-0 victory, hastened to move out into the streets and celebrate before the exit gates could be opened.

Prime Minister George Rallis went to the scene of the accident to supervise rescue efforts, and along with the leader of the opposition Socialist Party, Andreas Papandreou, issued statements describing the accident as a "tragedy for the nation and its sporting spirit."

The state radio and television interrupted their regular programs to broadcast classical music in mourning for the dead, while the soccer federation canceled next week's games.

Crowd Force Required to Bend 2" diameter steel pipe stanchion



1. Bending Moment = p# x 30 inches
2. Bending Stress = $\frac{\text{Bending Moment}}{\text{Section Modulus}}$
3. Using Elastic limit 60,000 psi ±

* $p = \frac{60{,}000 \text{ psi} \times .561 \text{ inch}^3}{30 \text{ inches}}$

$p = 1122\#$

*NOTES: Yield Strength Steel = 36,000 #/SI ±

Elastic Limit = 60-70,000 #/SI ±

Section Moduli 2" diameter pipe = Standard Weight Pipe = 0.561 $inch^3$

= Extra Strong Pipe - 0.731 $inch^3$

= Double Extra Strong Pipe - 1.10 $inch^3$

Rolling Stone

'1941' STEVEN SPIELBERG CHRISTMAS TURKEY

ROCK & ROLL TRAGEDY

We didn't call it festival seating. We called it animal seating, because when they came in, they came in like a herd of cattle.

—A RIVERFRONT COLISEUM EMPLOYEE

BY CHET FLIPPO

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WHY ELEVEN DIED IN CINCINNATI

AT ABOUT 7:15 on the evening of December 3rd, 1979, Larry Magid sat down to dinner with Frank Wood in the luxurious Beehive Club, a private club in the upper reaches of Cincinnati's Riverfront Coliseum. Wood, who is general manager of the city's premier rock station, WEBN-FM, remarked to Magid, who is head of Electric Factory of Philadelphia (one of the country's leading rock promoters), that the crowd streaming onto the coliseum floor far below them for that evening's Electric Factory-promoted Who concert seemed to be quite orderly. A "happy crowd," he said, not at all like the rabble that had disrupted previous "chain-saw concerts" there, like the Outlaws' fighting crowd and Led Zeppelin's mob. The crowd below them was sprinting to get as close as possible to the stage, in the grand tradition of "festival" or unreserved seating. By agreement of the coliseum management (the coliseum is privately owned), Electric Factory and the Who, mostly general-admission tickets had been sold: supposedly 3578 reserved seats in the loges at eleven dollars each and 14,770 general-admission tickets at ten dollars each.

A few of those thousands of young people—the youngest known was four years old—had blood on their shoes as they ran happily down the concrete steps into the "pit," the seatless area in front of the stage where the true fanatics stand throughout the show. But no one noticed. Some of the people who paused—dazed—(*Continued on page 10*)

Rolling Stone

ROCK & ROLL TRAGEDY

WHY

(Continued from cover) beside the green and white pizza stand just past the nine turnstiles at the main entrance had no shoes on at all, and some had lost other bits of clothing. But other than that, inside the hall, it at seemed to be business as usual: the familiar ragtag rock & roll army staggering into the hall after five or six hours of waiting outside in the cold for the doors to open and keeping warm and happy with herbs and beer and wine and each other.

Magid and Wood continued their leisurely dinner. They still had plenty of time before the Who would come on, which could actually be about twenty minutes after the scheduled starting time of eight p.m., because the band would be preceded by clips from the film *Quadrophenia*. Cal Levy, who runs Electric Factory's Cincinnati office, cruised the aisles. Things looked okay to him. He had noticed at about 1:30 that afternoon that a large crowd was congregating around the main entrance — two banks of eight glass doors each, situated in a large "V." Levy had found coliseum operations director Richard Morgan and asked him to put into effect a special security procedure they sometimes used, which was to station guards at ramp entrances and allow only ticket holders onto the plaza at the main entrance, thus eliminating the gate-crashing element. The coliseum's entry level — the concourse and plaza — is reachable only by a bridge from adjacent Riverfront Stadium, where most people park, and by ramps from street level. There were no police on the spacious plaza at 1:30. Levy suggested to Morgan that some should be there. Sixteen arrived at three p.m. and by four there were twenty-five. The coliseum hires off-duty police to patrol the outside, and for security within the coliseum employs guards from the Cincinnati Private Police Association.

At about 6:30, lieutenant Dale Menkhaus, who headed the twenty-five-man detail outside, decided that the 8000 or so people who were now packed around the banks of doors were beginning to present a problem. The doors weren't scheduled to open until seven, but the crowd could hear the Who conducting its sound check and wanted in. It was thirty-six degrees and the wind coming off the Ohio River made it feel much colder. Menkhaus later said he told Levy and Morgan to open some doors; Levy told him the doors couldn't be opened till the sound check was over. Menkhaus was also told there weren't enough ticket takers. Morgan, as is the case with all coliseum employees, has no comment.

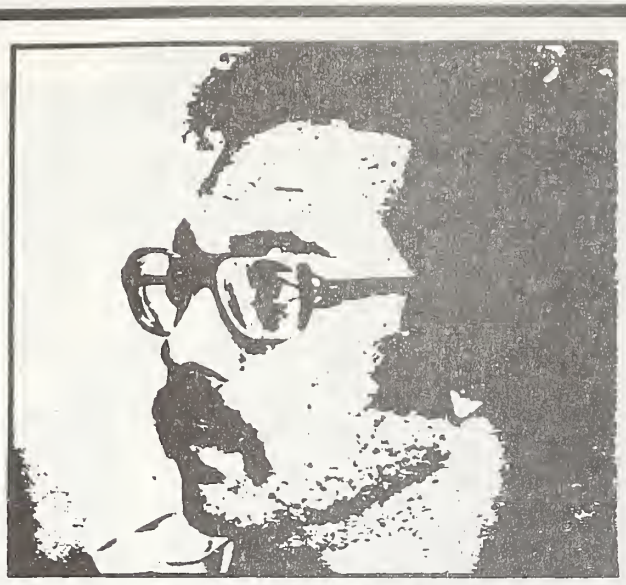
BODY COUNT AFTER SHOW (UPPER LEFT); SHOES AND CLOTHING LOST IN THE CRUSH (CENTER); MEMORIAL FOR VICTIM (RIGHT)

At seven p.m., the Who left the stage. No one inside the coliseum knew that while they ate dinner and conducted business as usual and waited until the appointed time to admit the "animals," just outside those front doors the horror had already begun, a horror under a full moon, a horror of chilling magnitude that will probably never be fully explained.

ON JUNE 28TH, 1976, A young man named Richard Klopp sat down to his typewriter in his apartment on Auburn Avenue in Cincinnati. He was slow to anger but he was angry. That morning he had gone out bright and early to buy tickets to see Neil Young and Stephen Stills at the coliseum. He got to Ticketron an hour ahead of time because he wanted good seats, only to find that tickets were sold out because they had gone on sale three days before the date advertised by Electric Factory. Klopp was already unhappy about the last two Electric Factory shows he'd been to, so he just said, "By God, I'll send them a concerned citizen letter" — and just to be sure they didn't just blow him off as some rock druggie, he decided to send carbon copies to the city council, WEBN, Ticketron and to the Cincinnati public-safety director.

He wrote: "The two concerts that I have attended (the Who and Paul McCartney) were both sold out on a 'festival seating' or general-admission basis. What this means for the promoter is more money; for the concertgoer . . . this means that he'll probably have to sit in the aisles or on the floor . . . jeopardizing his safety and the safety of others. If a fire or general panic were to break out, many, many people would be trampled to death. . . . Because civil people like to avoid these kinds of conflagrations, many concertgoers make a point of arriving at the coliseum two, three, and even four hours before the doors are 'scheduled' to open. At the Paul McCartney concert, for example, I arrived at 5:30, two hours before the doors were to open. After a span of two hours, several thousand people had congregated on the plaza in front of the doors. When they were finally opened (a half-hour late) the mass of people pressed forward, literally crushing those by the doors. . . . This is what happens when tickets are sold on a 'festival seating' basis, and it is no festival."

On the night of De- [Cont. on 12]



Larry Magid: a promoter under fire

LESS THAN TWO years ago, Peter Wertimer, a former employee of promoter Larry Magid's Electric Factory Concerts, warned of the possibility of just such a tragedy as the one that occurred before the Who concert in Cincinnati. Wertimer testified in a deposition for an antitrust suit brought by a rival promoter, the Midnight Sun Company, for whom he also had worked. He recalled that at some general-admission Electric Factory shows at Philadelphia's Spectrum, "There was no attempt to form any lines other than the ones that the people formed initially themselves. But as the doors would open, there would be a huge crush forward into those doors. They're large glass or see-through doors that get pushed out into the crowd, and [with] the crush of the people into those doors, you have a situation where people could get pushed through the doors and, if not anything extreme, just a severe crush right at the point of contact between the crowd and where those doors were opening."

Magid responds to allegations of such past problems by saying, "I really don't want to comment on that — you'd have to speak to the lawyer about that. Whether I'm aware of it or not remains to be seen." As to responsibility for security at concerts, Magid says, "We [promoters] are not anything but tenants. We are not owners of the building. I'm not pointing fingers at anybody. I hear this idea that it [Cincinnati] happened because the promoter didn't have his shit together. You hear people saying, 'It couldn't happen here in Providence,' or whatever. Bullshit! It's a symptom of a society, and it could have happened anywhere. In fact, it has happened at soccer games in other countries. I just think it goes a lot deeper, where the responsibility lies and who to blame, no matter who didn't do what. After all, we didn't trample anyone to death, and we didn't step on anyone, and we didn't push anyone."

The tragedy December 3rd in Cincinnati was not the first time that Larry Magid has come under fire for the way he runs his business. Within the last three years, Magid, one of the country's largest promoters, has been the target of at least five antitrust suits filed by rival promoters. One of those suits was recently settled out of court and four are still pending. In addition, Magid was the subject of a yearlong grand jury investigation initiated by the Justice Department's antitrust division. (The grand jury adjourned without bringing any indictments.)

And there have been other problems. In two successive years, 1977 and 1978, members of Aerosmith were seriously injured onstage by flying objects during concerts at Philadelphia's Spectrum, where Magid books many of his concerts. Both concerts were sold on a general-admission and reserved-seat basis.

As for the future of festival (general-admission) seating, Magid says, "An awful lot of attractions want to play festival seating...and an awful lot of the audience want it, too. I think we're probably not going to see festival seating in bigger places anymore. I think there'll probably be legislation against it now. I may not wait until legislation comes out."

[Cont. from 10] cember 3rd, 1979, as Richard Klopp was caught up in the horror on the plaza and saw his wife swept away from him in the crush, it didn't immediately occur to him that what he had forecast was suddenly happening to *him*. He was just trying to survive. Klopp is six feet two and weighs over 200 pounds, but he went down; the pressure from those behind him toppled him. He was flat on his face on the concrete, and those marching, charging feet were all around him. It was no great comfort that city councilman Jerry Springer had actually replied sympathetically to his letter — no one else did, and Springer never *actually* was able to get anything done. What Klopp felt, oddly, as he wondered whether he would live or die, was *anger* at Cincinnati's establishment, at the forces that made him get a general-admission ticket when he wanted a reserved seat, at whoever it was that wouldn't open those doors to relieve the crowd pressure. He seldom went to rock concerts anymore, but he had really wanted to see the Who and had gone to Ticketron an hour early. All tickets had been sold by the time he got to the window; he saw scalpers buying a hundred tickets each. Klopp ended up paying sixty dollars for tickets for himself and his wife.

He had gotten to the plaza at 2:40 the afternoon of December 3rd because he wanted to be sure they got good seats; he had brought a book with him to read. That book, *Structuralist Poetics* by Jonathan Culler, was still in his right hand as he lay on the concrete. Someone, miraculously, helped him to his feet and he was back in the crush, his arms pinned to his sides. At one point he was within five feet of a closed door, but he had no control over his movement. At times his feet were off the ground. Despite the cold, he was drenched in sweat. He couldn't breathe. He and everyone around him had their heads tilted straight back, their noses up to try to get some air. He noticed that an actual steam, a *vapor*, was rising off the crowd in the moonlight. He would later be angered to read that it was a "stampede," because to him it was a concentration of too many people in too small a space with nowhere to go but forward—people in the back were yelling, "One, two, three, push!" but they didn't know people in the front were falling. There was little noise. Some people tried to calm those who were panicking. Some shouted, "Stay up! Stay up or you're gone!" Some chanted, "Open the fucking doors!"

The forward crush continued and pressed up against those closed doors; the crush had started around 6:15 and ground on for an hour and a half or so. Klopp noticed that there were actual human waves swaying like palm trees in a hurricane. He saved his life by seeking out the eye of the hurricane, and he was swept out of the crush.

He couldn't find his wife. He ran to the first policeman he saw and shouted, "What are you *doing*? People are getting *trampled* up there." The policeman looked him over and asked, "What do you do for a living?" Klopp replied, almost in shock, "Working on a Ph.D. in language." The policeman said, "Well, you just used a dangling participle." Klopp, caught up in the absurdity, said, "I think I know more about language than you do." The policeman smiled: "Well, don't tell me how to do my job, then." Klopp lost his temper: "People are getting *hurt*." The policeman said, "Well, we can't do anything." Klopp finally got inside and found his wife.

A few feet away, Mark Helmkamp was pleading with a policeman to do something. He said to the cop, "Here, take my ID and bust me for false information if you don't believe me." He said the policeman told him to move along.

A day later, Helmkamp was still furious. "I was greatly disturbed by WCPO-TV's depiction of us as a drug-crazed mob. There were too many people and just two doors open. It was an incredible bottleneck; it was a slow squeeze, not a stampede. I was stuck in it for forty-five minutes. I went down twice and wasn't sure that I would make it. I saw guys with blue lips — they couldn't get oxygen. I saw, I think, four ticket takers after I walked over all the shoes to get in. I couldn't keep my feet on the ground the whole time. I kept my arms in front of my chest to keep from getting crushed. People were climbing up on other people's shoulders. Some people went berserk and started swinging their elbows. That was the only blood. There was no group panic. After I saw the dead people, it sunk in. Dead. Just dead. It pissed me off to see Uncle Walter Cronkite blaming us for this."

'People were climbing on other people's shoulders. Some people went berserk and started swinging their elbows.'

The doors were officially opened at 7:05; according to eyewitnesses, four doors out of the sixteen were open, and two of those were closed and blocked at times by guards with billy clubs. From where he was in the crowd, Phil Sheridan saw only one door open. "It looked like they attempted to open more but the crowd was so tightly packed, it was useless. I was maybe fifteen rows of people back, staring at this door, and it hung like about six inches open and they finally sprung it open and that's all I remember till I got inside. I could see people smashed up against the doors that weren't open. I had ahold of my girlfriend and my buddy grabbed me by the shoulders and I took him by the hand and we started to make our way through the turnstiles. Well, in that ten or fifteen seconds it took us to get our act together, we were now inside between the doors and the turnstiles and the door was a frenzy and they're still trying to take tickets! God, it was insane! I was three [Cont. on 22]

PHOTOGRAPH BY NEIL BENSON

CINCINNATI

[*Cont. from 12*] abreast in this goddamn turnstile, which was only eighteen inches wide! People were getting hurled in and shoved through the turnstiles and the ticket takers were still saying, 'Hey, where's your ticket?' The initial rush came about 6:30 because that's when people smelled blood, you know, the magic hour, they're finally gonna open the doors for us. There was continuous pushing till seven and then the doors opened shortly after that. God, this one girl, it must have been twenty minutes before the doors opened and all of a sudden I feel a tug on my arm; it's this girl, and her head was at my waist and she said, 'Excuse me, my feet are back there somewhere.' She was *horizontal*.

"I went back out to look for my friends; I saw—and this is after the show started, which was about 8:20—I saw the same scene. It was still crazy. It was crazier between the outside doors and the turnstiles than it was outside, 'cause by then people were really going for broke. I found my friend Bill and he said he saw people going over the tops of the doors, he saw bodies piled in front of the door, and people were going over them and around them any way they could. At about nine, I saw more waves of people. I looked outside and saw what must have been thousands of dollars' worth of personal articles strewn everywhere, these terrible piles of shoes, shoes trapped in that chain-link fencing behind the turnstiles. I wonder about the kinds of injuries that weren't reported."

THE TWENTY-FIVE-man police force outside finally found the first body at 7:54 p.m. After the ambulances and the fire department and the fire chief and the mayor and the city safety director and the Flying Squad from the Academy of Medicine and additional police and the TV crews and everybody else got there, they finally understood that this was serious. Cincinnati proper put on its serious face. TV crews were asking onlookers if drugs and alcohol hadn't caused this "stampede."

Mayor Ken Blackwell—this was his first day on the job—was summoned from his dinner with House Speaker Tip O'Neill and said it looked to him like this awful tragedy had been caused by "festive seating." It was his decision to continue the concert, lest the many thousands inside riot if the show were stopped.

Promoter Larry Magid said he first learned of the trouble at 8:45 from a coliseum employee and went backstage to tell the Who's manager, Bill Curbishly, that there were four dead, "two O.D.s and two crushed." According to Curbishly, the fire marshall arrived and said he thought there was a mass overdosage. He wanted to stop the concert; then he learned that the deaths were due to asphyxiation and that people were still being treated on the plaza level.

Curbishly told him it would be senseless to stop the concert, that there could be a riot and people might stampede back across the plaza. The fire marshall said, "I agree with you totally."

By the time the show was over, Curbishly knew of eleven deaths. He told the Who that something serious had happened and they should hurry their encore. After the brief encore, he took them into the tuning room and told them of the deaths. They were devastated.

"Initially, we felt stunned and empty," said Roger Daltrey three days after the concert. "We felt we couldn't go on. But you gotta. There's no point in stopping."

Lieutenant Menkhaus said sixteen doors were open and Cal Levy echoed that; Electric Factory attorney Tom Gould said nine to eleven doors were open and Roger Daltrey said three were open. Dozens of eyewitnesses told ROLLING STONE that never during the trouble were more than four doors open and that only two were open most of the time. The coliseum management still refuses to say how many tickets were sold, how many guards were on duty, how many ticket takers or ushers there were or anything else. Curbishly said Electric Factory paid $7800 to the coliseum for ushers, ticket takers, interior security, clean up.

Including emergency exits, there are 106 doors at the coliseum (although John Tafaro, spokesman for the coliseum, would not confirm or deny this number); why at times only two at the main entrance were open will be a point of speculation for some time.

When Riverfront Coliseum first opened on September 9th, 1975, with a concert by the Allman Brothers, an usher on duty named Donald Fox said that the coliseum had too many outside doors and that gates rather than glass doors should be installed at the main entrance on the plaza. His was the first of many warnings that were ignored. Riverfront Coliseum was trouble waiting to happen.

RIVERFRONT COLISEUM exists because a man named Brian Heekin wanted a hockey team in Cincinnati and therefore needed an arena. Heekin and his brother, Trey, and their friend William DeWitt Jr., all great sports fans, were the guiding forces behind the coliseum. In the early Seventies, Brian—whose great-grandfather formed the Heekin Can Company, which was the family's fortune and its entree into Cincinnati's relatively small business and social elite—had tried to buy the Kentucky Colonels of the American Basketball Association and bring them to Cincinnati; he lost out to now-Kentucky Governor John Y. Brown. But Heekin really wanted and sought a National Hockey League team. When Cincinnati began talking about a renewal project for the riverfront area, Heekin popped up with the idea of a big indoor sports arena there. He initially wanted the city to build it and lease it to his Cincinnati Hockey Club (later changed to Cincinnati Sports Inc.). The city came close to financing and building such an arena. Heekin tried and failed to get local banks to finance an $18-million arena. Heekin was offering the city an NHL team, the ABA Colonels and a World Team Tennis franchise. After it seemed to him that the city was not going to help him, Heekin decided to build his arena in the suburbs. All of a sudden he got what he called "unbelievable" pressure from local businessmen to build at the waterfront. And all of a sudden he began getting local support. The chamber of commerce got behind the idea, the governor offered to help with state revenue bonds, and then, before anyone knew what was happening, the chamber of commerce called a press conference on August 8th, 1973, to announce that a sports arena would be built at the riverfront, that local banks and savings and loan associations would put up $10 million in state industrial revenue bonds, that $4 million would come from Heekin's Cincinnati Sports Inc., that another $4 million was forthcoming from city, state and federal funds, and that a final $1 million would come from leasing the arena's posh sky boxes to wealthy patrons. Heekin's newly formed Cincinnati Coliseum Corporation bought three acres of land next to Riverfront Stadium from the city for $200,000. The McNulty Company of Minneapolis drew up the plans, and the Universal Contracting Corporation of Norwood, Ohio, was contracted to build it. The city ended up using state highway funds and federal funds to build the elaborate sky bridges that connect the coliseum concourse to street level. Thus, all the concrete right outside the coliseum doors is city property. That's where the eleven died.

Heekin never did get the NHL franchise he said he had, nor did he get a World Team Tennis franchise. The Kentucky Colonels did play a few games there before pulling out. Gradually, as with so many such arenas around the country, rock shows supported the place. Instead of an NHL team, Heekin got the World Hockey Association Stingers, hardly a major draw. When the WHA folded and the Stingers were absorbed into the Central Hockey League, Heekin's corporation got what was said to be a settlement close to $3 million and the Stingers continued to play in the coliseum, paying rent of $4000 a game. The Stingers played there two nights after the Who and drew 869 paying fans. The University of Cincinnati basketball team still plays games at the coliseum but has reportedly considered pulling out in the past because of heating problems, among other things. At the start of one game between two other teams, the players sat huddled in blankets because the temperature inside was in the forties. After the Who show, the NCAA decided to reject the coliseum's bid for basketball finals there, although the NCAA claims the decision had nothing to do with the tragedy. Promoters canceled the two remaining rock shows of 1979 after the Who show. Local journalists said the coliseum's future was not bright. Big events there the past year have been a tractor-pulling contest and a Jehovah's Witnesses convention.

The coliseum's first fatality came on October 4th, 1975, when seventeen-year-old Thomas Lambert, pursued by police who said he had cursed them, jumped or fell to his death from the plaza level to the street below.

Security problems have been noticeable at the coliseum. In March 1976, police officer Walter Scott told the *Cincinnati Enquirer* that there had been many incidents in which coliseum personnel refused to cooperate in emergency situations. He said he was worried that a life-or-death situation might arise. On August 3rd, 1976, when Elton John played the arena, there was big trouble. A crowd of about 2000 rushed the doors. No one was hurt badly, but police and fire officials found numerous fire-code violations, including locked exit doors. An editorial in the *Enquirer* the next day said that things weren't right at the coliseum during rock shows, but it concluded: "We'd be surprised, though, if the Elton John fracas is repeated anytime soon." On August 5th, 1976, fire captain Ed Schneier told local media that problems were getting worse at the coliseum because of festival seating, and that kids were gathering there earlier and earlier because of it. Fire captain James Gamm said that festival seating was a problem because, in a case of serious trouble inside the coliseum, bodies could "pile up in a major catastrophe."

CAL LEVY, ELECTRIC FACTORY'S CINCINNATI MAN

PHOTOGRAPH BY STEVE SMITH

City councilman Springer said publicly that festival seating caused a "climate of disorder." Brian Heekin disagreed, saying that Springer was not qualified to comment on people's behavior at concerts and that kids liked festival seating. Heekin also said he wouldn't mind talking with city officials about the problem of people urinating outside the coliseum.

Also on August 5th, Brian Heekin, coliseum operations director Richard Morgan and security director James Madgett were each charged with one count of failure to comply with ten lawful orders of the fire chief regarding building-code violations at the

In 1976, the city was warned about festival seating.

Elton John show. "The city is just trying to cover its tracks," Heekin told the *Enquirer*. "It's city property outside the doors."

According to the *Cincinnati Post*, Heekin pleaded no contest to the charge and was fined $100. The charges against Morgan and Madgett were dismissed.

On August 8th, 1976, an unnamed security guard at the coliseum told the *Enquirer* that festival-seating concerts were always oversold — he thought they were crowding 20,000 into the place.

On August 11th, 1976, an editorial in the *Enquirer* said, "There is no reason to justify a ticket-selling procedure that encourages early congregation on the...plaza. Experience has shown repeatedly that gatherings of this kind are open invitations to trouble.... Management would be prudent in installing staggered rails so that ticket lines could more easily be kept orderly."

That same day, city manager William Donaldson organized a task force to draw up a plan for security at rock shows at the coliseum. "We want," said Donaldson, "to make sure their operation never again is an occasion for risk to the citizens of Cincinnati."

Three of the seven members of this Public Safety Study Team were from the coliseum: Heekin, Morgan and Madgett. The other four were from city government. Their report, issued August 24th, 1976, said in so many words that in the future, everything would be fine and dandy at the coliseum. Section Three of the report, regarding festival seating, said: "The matter of 'Festival Seating' (nonreserved seating) was briefly discussed; however, no recommendation is being made at this time. The team felt that we should first evaluate the results of improved fire safety and security methods before taking a firm position on seating arrangements. It would seem that if Fire Prevention Code requirements and security needs are fully met, that the method of seating may become a secondary concern."

A week earlier, on August 13th, 1976, Mayor Bobbie Sterne asked for a study of seat sales at rock shows and recommended that all seats be reserved.

And before that, on August 6th, 1976, fire chief Bert Luganani sent a memo to a city council member in which he said there were numerous fire-code violations at the coliseum and that the number of guards and open exits was not sufficient. The chief also addressed himself to the matter of festival seating: "Selling a concert on a general-admission basis (festival seating) allows for sale of a ticket for each fixed seat and each specified standing area (i.e., 15,800 seats; 1800 people permitted on the arena floor). Placement of the stage prohibits viewing the concert from approximately 4000 of the seats sold. Those persons have no recourse other than to congregate in the exit way if they desire to watch the performers. It has been recommended that the concerts be sold on a reserved-seat basis. It was felt by the responsible coliseum officials that this would create an economic hardship." Nothing was done. A second city safety report produced a similar nonreaction.

"Cincinnati as a city," said one member of the local "rock & roll establishment" who preferred not to be identified, "expects rock fans to be like Reds fans — who are actually worse. It's like you're supposed to be going to church. It was only a year ago that the Bengals allowed banners at the stadium. Maybe this happened because rock fans were regarded as lower than sports fans, who can do anything they want. Maybe this is a city that wants to be cosmopolitan without regarding rock fans as anything but a nuisance. But a nuisance that provided a lot of money. The coliseum was built as a sports arena. But rock & roll kept it afloat." The coliseum refused to comment about this.

There had been so many crisis flags sent up before that were ignored. Fleetwood Mac played the coliseum a month [*Cont. on 24*]

[*Cont. from 23*] before the Who, and even though seating for the Mac show was completely reserved, there was a bottleneck at the entrance because, according to an eyewitness, not enough doors were open.

The night of the Who concert, business continued as usual until eleven people died. Some blamed the victims for their own deaths, even though it has been proved that some of them — like David Heck, who got out of the crush and went back in to try to help others — died while trying to stop the madness even as police ignored them.

CINCINNATI moved quickly to blame "festival seating" for the tragedy, although no one explained why festival seating had been permitted for so long at the coliseum when previous concerts had proved it dangerous. No one explained why even though Ticketron claims ticket sales were limited to eight per person, scalpers were spotted leaving outlets with stacks of tickets. In the week after the concert only city councilman Jerry Springer said there should have been someone at the show with the authority to open the doors when there was obviously a disaster in the offing. No one said who could have had the authority. It had been business as usual for everyone. Dozens of concertgoers told ROLLING STONE that they had been treated like so many sheep to be herded through so many doors. The *Cincinnati Enquirer*'s banner headline of December 5th read: ALL DENY BLAME FOR TRAGEDY. And that's probably where it will stand. After the show, Pete Townshend said he felt partly responsible because, "It's a rock & roll event that has created this, and we feel deeply a part of rock & roll." Local commentators tried to pitch drugs and alcohol as the reason for the alleged "stampede."

A team of ROLLING STONE reporters visited the coliseum and got as many "no comments" as it could use for ten years.

Electric Factory's Cal Levy did agree to talk. Levy, who actually was the show's promoter — Magid had come in just to see the Who — was visibly shaken. He contended he had had no control over the opening of doors or the number of guards.

He paced his attorney's office in the twenty-sixth floor of Carew Tower in downtown Cincinnati, stroked his beard, and said, "Hey, I'm no Bill Graham, okay? I just think that when all the facts are known, all the reports are completed, that it will show that there was a combination of things that brought about an uncontrollable situation on that plaza.

"All the procedures used Monday night were the procedures that were implemented on all the previous shows where nothing ever went wrong."

Could he have had the authority to order those front doors opened when it became apparent they should be opened?

"No. Our only responsibility is to get the group onstage, to pay for staffing at the coliseum" (although he said he had no responsibility for the size of the staff). He said Electric Factory had provided "peer security" (i.e., young people who are not in uniform) for the floor-level general-admission area and had arranged to have paramedics and ambulances ready.

Electric Factory's attorney, Tom Gould, said he thought that everybody concerned had a zone of responsibility and that everybody discharged "what they thought

Business continued as usual until eleven people died.

was in the best interest and was the right thing to do." Levy and Gould both said that maybe no one was at fault; perhaps it was a natural disaster.

Levy was quick to point out that Electric Factory had promoted Cincinnati's first outdoor rock show, the Eagles, at Riverfront Stadium. "We had 52,000 kids, general admission and the same parties involved in the planning. Dale Menkhaus and I worked extensively on the security. And nothing happened. But what I think we're faced with here is unusual circumstances that all merged at one time and in one place. Maybe there were enough doors; were they open early enough? Was there a high level of drugs or intoxication? The music from the inside?"

But, he was reminded, things had gone wrong before. Some earlier shows had been violent.

"I can't deny that there are problems at shows; it happens everywhere in the country, right? Nobody could predict it, and I don't feel anybody could have controlled it."

Soon thereafter came the first of what will undoubtedly be an unending series of lawsuits. Todd Volkman, a person who was allegedly injured, filed a $12-million class-action suit (which can be expanded to recover tens of millions) against the promoter, the coliseum and the Who. Not the city of Cincinnati, on whose property he was allegedly injured. A second, filed by Betty Snyder, mother of the late Phillip Snyder, does name the city as one of the defendants. In that $10.25-million suit, the city is accused of negligence in its failure to follow the advice from its own Human Relations Commission to ban festival seating. It also alleges the city police were negligent in failing to enforce drug and liquor laws. (The police reported twenty-eight arrests for drugs and disorderly conduct on the plaza the night of the concert.)

One local lawyer said gleefully that there isn't enough liability insurance in the world to cover the potential lawsuits that could come out of the Who show. Under Ohio law, parties who feel injured physically or emotionally (a hot line was immediately set up for the emotionally warped) have two years to file suit.

The city of Cincinnati registered immediate civic outrage. No more festival seating, *probably*, said the city government. A task force was set up to find out what was wrong. Frank Wood of WEBN-FM was named to it. He said that he was not sure what the task force could do, all he knew was that he had read in the morning paper that "I'm not allowed to point a finger at anyone, and I think that's a shame." The task force has no subpoena power, and it was widely viewed in Cincinnati as window dressing.

The coroner's office said the dead apparently died from "suffocation by asphyxiation due to compression" and "suffocation due to accidental mob stampede." Toxicology tests for drug or alcohol residues in the victims were forthcoming.

An editorial in the *Cincinnati Post* said the coliseum had been the city's "citadel of lawlessness." Mark Helmkamp called home to tell his folks he was okay and he got a pot lecture. The victims were blamed.

Promoters across the country blamed festival seating. Larry Magid said that he felt terrible and that he personally didn't like festival seating, but that's what the kids wanted. A kid in Cincinnati printed up a few T-shirts that read I SURVIVED THE WHO CONCERT.

Roger Daltrey, weary and shaken, said, "It was really a freak; it's not a nightly occurrence, you know."

The mayor of Providence, Rhode Island, canceled the Who show there, saying that after two performances, the Who was averaging 5.5 fatalities per show. Angry kids marched in Cincinnati and in Providence to say that rock & roll should not be automatically blamed. They got little support.

OBSERVATIONS OF CROWD CONDITIONS AT ROCK CONCERT IN EXHIBITION STADIUM, TORONTO 16 JULY 1980

By Jake Pauls
Ottawa, Canada

INTRODUCTION

Crowd incidents, in which people are seriously injured or killed due to crushing or trampling, are not restricted to emergencies such as fire or to conditions of crowd violence or even simply exuberance of some members of a crowd. Such events can occur, and have occurred at sports events, religious gatherings and rock music concerts. Serious injury and even death can occur during entry, occupancy and evacuation of a building. It can happen under conditions that might, in every other respect, appear to be normal even to people in close proximity to those hurt in the incident.

Two major crowd incidents in North America and Britain during the last decade have led to intensive investigation of design and operating measures that might be useful in reducing the chance of serious crowd incidents. The first occurred in 1971 at Ibrox Park, a stadium in Glasgow, Scotland, as spectators left near the end of a soccer match. Here 66 people died in a crowd crush on a wide stair. This led to an inquiry described in Lord Wheatley's Report (1), including a study by a Technical Support Group described in part in the SCICON report, Safety in Football Stadia (2). From this came a new standard for crowd safety at football grounds (3), legislation on crowd safety (4), and regulations for implementing crowd safety measures (5). One of the findings of the technical study commissioned for Lord Wheatley's Inquiry was that, between 1902 and 1972, 125 people had been killed and over a thousand injured in accidents at football matches in Great Britain. Included were four serious incidents at Ibrox Park stadium, three of them resulting in 68 deaths and 219 injuries during egress on a stair (2).

In December 1979 eleven young people were killed and about the same number were injured in a crowd attempting to enter Riverfront Coliseum in Cincinnati for a rock concert by the group, The Who. No offical comprehensive report on this incident has been published. Among published accounts the extensive one in the magazine Rolling Stone, 24 January 1980, is recommended for its treatment of the incident from the point of view of participants (6). An official report of the Task Force on Crowd Control and Safety, set up by the City of Cincinnati, does not deal with the specific incident but rather provides a useful general discussion and set of recommendations relating to crowd management, seating, police services, architectural planning and design, emergency medical and ambulance services, successful crowd management techniques, national crowd management standards, plus existing and proposed laws and guidelines for Cincinnati (7).

The Cincinnati Task Force report was released only a week before a major concert by The Who and other rock music groups was to be held on 16 July 1980 in Exhibition Stadium in Toronto. In addition to a general concern about problems of entry to the stadium there was major concern by the City of Toronto Department of Buildings and Inspections regarding the adequacy of exit facilities from the playing field area to be used, in addition to permanent grandstands, for the unusually large crowd expected for the concert. A court injunction sought by the City, to limit the number of people on the playing

field, was not granted. On the morning of the concert, an invitation was extended by representatives of the show promoter and the City to the author to conduct observations of crowd conditions at the concert with a view to providing technical information which might assist in establishing safety guidelines for future rock concerts in Exhibition Stadium.

The following report records observations by the author during the event. With the decision to conduct the observations coming only hours before the gates were to open, and the need to travel from Ottawa to Toronto, it was not possible to arrange detailed documentation techniques. Fortunately it was possible to conduct observations in conjunction with several staff from the City of Toronto Department of Buildings and Inspections. One of these filmed crowd behaviour using a handheld Super-8 film camera, thus providing a useful record of several important aspects of the event - a record that was subsequently edited into a 12-minute Super-8 film held by the City Department of Buildings and Inspections. This film complements other photographic, audio tape and written records made by the author.

Before considering the observations it is useful to note what management, police and first aid resources were present in and around Exhibition Stadium during the concert. Providing most of the ticket control service were 84 ushers and usherettes plus 50 security guards. All of these wore uniforms of a private security firm. There were 125 Toronto police, in normal uniform and plainclothes, inside the stadium and around its perimeter. St. John Ambulance had two first aid posts in the stadium along with many volunteers. There were, in addition, regular ambulance services standing by inside the stadium and immeditely outside its gates. (These were used to take some thirty concert attendees to hospital before the event ended.) The show promoter provided approximately 100 personnel. Many of these were peer security - individuals who work closely and somewhat informally with the crowd to manage security particularly in the forestage and back stage areas. Their background and appearance influence their acceptance by spectators as peers. In this case members of the peer security force wore jeans and blue T-shirts on which was printed "Please feel secure" - an ironic comment in view of the tightly-jammed conditions that occurred later in front of the stage.

These following observations cover a nine-hour period beginning several hours after the gates opened at 13:00 through to 01:00 when the stadium was almost clear of patrons. Until 20:30 observations were conducted from various places in the stadium. After this, with movement through the crowd difficult if not impossible, all observations were conducted from the press box on the roof of the north grandstand where a useful overview was obtained of most of the stadium and its vicinity.

The show was scheduled to begin about 18:00 with three groups, Nash the Slash, J. Geils Band, and Heart, preceding The Who. The last of the three groups, Heart, scheduled to end at 21:15, finished at 21:57. The Who began its performance about one-half hour late at 22:37 and finished its encore at 00:48.

CONDITIONS AT 16:00

The grandstands were almost empty. The initial entry rush of people (who had been waiting a long time for the gates to open) was long past and they were scattered at a fairly comfortable density in the field area. See Figure 1 for a plan of the stadium and Figure 2 for a photograph taken from the south grandstand looking across the field toward the stage. Several thousand people were able to sit comfortably or even lie down in the area between two lighting towers and the stage. (This is similar to the conditions shown in Figure 3.) A similar number of people might have been scattered at lower density on the field behind the lighting towers (Figure 3).

Not including circulation areas to each side, the total area of field available for those holding "festival seating" admission tickets was approximately 3,350 square metres (36,000 square feet) in front of the two lighting towers and 8,360 square metres (90,000 square feet) behind the towers. Adding 1,500 square metres (16,000 square feet) for circulation paths and barricades adjacent to the side grandstands gives a total of 13,200 square metres (142,000 square feet) for playing field occupancy. (Not included in this total is the area on and around the baseball diamond at the southwest corner of the field; it was fenced off and not available for occupancy.)

Figure 4 shows an area approximately 9 metres (30 feet) deep immediately in front of the stage that was being maintained clear at his time by peer security. Two relatively unoccupied areas, with obstructed views of the stage, were behind each lighting tower. Between the field area and the two side grandstands, barricades were erected with several openings permitting control of movement between the field and the grandstands where washrooms and almost all concessions were located. A movement corridor was left on the field side of these barricades.

A few instances were noted of people who had passed out or were otherwise suffering from the effects of drugs, alcohol, the heat, and perhaps food (singly or in combination). St. John Ambulance volunteers sent some of these people to hospital. Late in the afternoon a short discussion was held with the person who headed the operations of St. John Ambulance personnel at the event. This revealed that most of the cases they dealt with were due to such "self-inflicted" conditions. Accidents involving building features were reported to be more common in a large local arena where some aisle stairs appeared to be unusually precarious.

Several other informal discussions with St. John Ambulance personnel and people working with the Stadium Corporation stressed the different behaviour that could be expected from different groups of patrons depending on the particular rock groups performing. The relatively rowdy and destructive nature of football spectators was also noted; the use of alcohol is apparently more prevalent in football games.

CONDITIONS AT 18:20

There were more people in the grandstands at this time and movement along the cross aisle in the new south grandstand was becoming difficult due to the congestion. The clear area in front of the stage had disappeared about an hour earlier and peer security had moved to a narrow barricaded area immediately in front of the stage.

The density, where it could be assessed at the edge of the crowd, was judged by the author to be about one person for every 0.3 square metre (3 square feet) of field area. The density appeared to be greater immediately in front of the stage. Of course people were standing at this density, whereas previously many had been sitting or lying down. Figure 5 is a newspaper photograph, taken from the stage, showing the dangerously dense crowd condition that was maintained here for up to seven hours.

The general mood of the crowd appeared to be quite good. Frisbees and large inflated balls were being tossed around the field and the grandstands. An exception to this relatively safe play occurred when someone in the southeast corner fired a smoke flare low across the heads of the patrons in the direction of the south lighting tower. This appeared to be a dangerous projectile capable of seriously injuring people.

Movement through the crowd was still on an "excuse me" basis. Normal conventions such as the "keep-to-the-right" rule were being adhered to in the movement corridors that had been created on the field side of the barricades separating the side grandstands from the field. Movement here was possible with minor difficulty. Moreover there were still relatively clear areas on the field immediately behind each lighting tower.

At least one instance was seen of what appeared to be small amounts of drugs being sold on the field. The smoking of marijuana was prevalent throughout the field and the grandstands. A very small amount of drinking was going on, sometimes from 12 oz. size liquor bottles. There were dazed looks on the faces of some patrons. (It should be noted that, outside the stadium there was much evidence of patrons drinking before entering the stadium.) Police searches for contraband were being conducted at the entry gates just before patrons went through ticket control. This search process at the west gate (Gate A) was observed for approximately 20 minutes and inconsistencies were noted in the thoroughness of the searches. Most patrons were unaware of the relative ease with which they could occasionally get by particular officers; however a few people were observed to switch lanes and move relatively quickly and unchecked past certain officers. There may have been other gaps in the search system at gates for passholders where at least one large shoulder bag went through unchecked.

The checking of tickets at the openings between the grandstands and the field appeared to be inconsistent during the afternoon and the early part of the evening. This process, being done by peer security, appeared to break down completely during the evening and there was little evidence over most of the evening that there was any control on the number of peole allowed onto the field. After sunset, about an hour before The Who were scheduled to begin, such ticket control was almost impossible because of the darkness and the congestion of the crowd even in the relatively accessible movement paths next to the barricades adjoining the side grandstands. There was effectively no control over the number or distribution of patrons on the field. Many of the peer security personnel seemed to be concerned with protecting the stage area and pulling patrons out of the dense mass in front of the stage. The people being pulled out at this time appeared to be in good condition but it was difficult to tell from a great distance.

CONDITIONS AT 21:00

Observations from the vantage point of the roof-top press box overlooking the field near the stage, along with closer observations earlier on the field level and a general knowledge of crowd behaviour (from the literature and from extensive experience with field studies), led to the following estimates of the distribution of densities and populations on the field and in the grandstands. These are described in terms of the areas set out in Figure 1.

> Area 1 immediately in front of the stage, with approximately 700 square metres (7,500 square feet), was occupied by patrons who each had about 0.2 square metre (2 square feet) or less area. Those closest to centre stage were packed so tightly that any independent movement or egress from the area was all but impossible (as shown in Figure 5, a photograph taken earlier in the evening).
>
> Area 2, in front of and between the two lighting towers, with 836 square metres (9,000 square feet), appeared to be occupied at a density of one person for each 0.2 to 0.4 square metre (2 to 4 square feet) of area.
>
> Area 3, with most of the remaining area in front of the lighting towers, had 1,860 square metres (20,000 square feet) in area and held a crowd with a density averaging one person for every 0.4 to 0.5 square metre (4 to 5 square feet).
>
> Area 4, totalling around 8,360 square metres (90,000 square feet), was occupied at a wide range of density with patrons each having between 0.4 and 0.9 square metre (4 and 10 square feet) of area.
>
> Additional areas totalling perhaps 1,500 square metres (16,000 square feet), at the sides near the grandstands, which earlier were routes of movement, had by this time become congested with patrons at a density of one person for every 0.3 to 0.4 square metre (3 to 4 square feet). One reason for the high density along the sides was the presence of a narrow, slightly elevated platform on the north side which was tightly packed with people wanting to get a better view over he field.

The population on the field at 21:00 is estimated to be as follows.

> Area 1 held 3,800 persons.
> Area 2 held 3,000 persons.
> Area 3 held 4,500 persons.
> Area 4 held 15,000 persons.
> Remaining areas to the sides held 4,600 persons.

This estimate, with a total of 31,000 persons on the field at 21:00, is subject to error; the actual population could have been about twenty percent smaller or larger (25,000 to 37,000 persons). There was no way to verify directly the

densities at the field except in the area immediately in front of the stage where there were indications that people were at critical packing density where each person has less than 0.2 square metre (2 square feet) available. There were many empty seats in the grandstands, including of course the large areas at the east ends of the grandstands where the stage could not be seen.

On the assumption that there were 71,000 persons in the stadium the occupancy of the grandstands was estimated to be 34,000 to 46,000 persons at 21:00.

In the area immediately in front of the stage the human wave or surge phenomenon was evident occasionally from 21:00 until the end of the concert nearly four hours later. Photographs such as Figure 5 make clear that even before sunset, when earlier rock groups were on stage and nearly two hours before The Who appeared, densities were at this packing or crushing level where individuals are not capable of independent movement. Judging from the extent of the wave phenomenon, seen from the press box overhead, between one thousand and two thousand patrons were in this area of critical density for at least several hours. For these people there appeared to be only one way out and that was to be pulled up and out of the crowd at or near the stage. The removal of such people continued throughout the evening and at times more than one person per minute was pulled out. This process was observed to require great effort on the part of those doing the pulling and could easily have resulted in injuries in addition to any suffered because of the crowd crush.

Other indications of distress for those in this crush situation included the frequent dousings with buckets of water and on one occasion from a small hose to help cool them down and relieve thirst. The field area was hot even without the bodies packed together for up to seven hours. Another indication that the density had reached extreme conditions was seen at the end of the evening as many shoes and miscellaneous personal articles littered the area immediately in front of the stage. The loss of shoes has been reported in previous crowd crush incidents.

CONDITIONS AROUND 22:00

Due to growing concern about the crowd crush conditions in front of the stage someone from a local radio station came on stage during the break before The Who performance. Using the public address system he appealed to people to move back. His tone was somewhat condescending and, for the most part, his urgings either were ignored or were followed by so few people that there was no significant change in the crowd condition.

Following this, at approximately 22:10, another person used the public address microphone to appeal again to the crowd. He sounded quite agitated and was obviously concerned about the critical nature of the crowd density. The following is a transcript of his announcements taken from an audio recording made as part of the evening's observations. The gaps in the transcript indicate that the announcements could not be clearly understood even when heard from the roof of the north grandstand far above the noisy crowd.

As well as indicating the frustration, perhaps even some feeling of helplessness on the part of the announcers, this transcript gives some idea of the important background to the concert itself. Because of their potentially large importance in crowd management the announcements are reproduced here as faithfully as possible.

> "I'm not from CHUM FM. I'm with . . . productions and together with CPI we've been bringing some nice concerts to Toronto for a long time. We're going to continue to bring spectaculars like The Who to this stadium but we're asking you for a little cooperation right now. To continue to bring the kind of acts that Michael and everybody else at CPI would love to get you to cooperate now. The building people, the City Police, all those people in the court are looking at you right now. They tried to stop the concert. We've got to show them now that they have no jurisdiction and no reason to do anything like it. I've got to ask you to move back! For us and for future concerts, take a step back and look out for your neighbour. Please be careful and please start to move back. It's going to be a great show and a great final act . . . . Please start to move back. (Loud cheering here.) We are going to prove to the rest of the world that a major musical event can take place in Toronto and work. Just a step back. Just keep taking a step back. Keep an eye on your neighbour. Some of you people are getting really crowded. There are some seats in the stands. Be conscious of that. The lights that The Who have brought with them you'll be able to see from anywhere in this stadium so you can just move back a litle bit. . . . Just keep moving back, a step, an inch, keep moving back!"

This series of announcements had some effect and there was a movement back, totalling several steps. Another announcer, apparently the one from the radio station who had attempted the first set of announcements, followed with further requests.

> "Ladies and gentlemen, help your fellow . . . you're standing beside and move back . . . middle. Come on. Listen they tried to stop this show but you people wanted to see it!" (At this point he was all but drowned out but rythmic applause, whistling, and cheering or jeering as he continued in a very tense voice to coax people to move back.) "Come on. Get yourself together. All you people at the back . . . now come on. Just move back a couple of steps. Watch out for each other. You don't have to trample each other. You don't have to push; you don't have to shove; you don't have to punch." (Continued clapping and cheering, almost drowning out the announcer.) "Ladies and Gentlemen, this is the largest audience this stadium has seen." (Very loud cheering and whistling.) "I'm not . . . down here to tell you that if we don't get people back here the City fathers, the bureaucrats, the people who have a say in this

> are going to refuse the . . . and we can't ever have a big concert like this here again. We're starting to get a little bit more room up front here. How about a little bit more . . . . Move back a little bit. Come on! (Uninteligible sentence.) Come on! We're going to try it again. We're going to try it again. Everybody move back one step at the count of three. It will make it easier that way. Are you ready? Help me out if you want to. One! Two! Three! One step! That's the stuff. That's it. Let's try it again. Everybody now. One! Two! Three! Move back! It's happening in the front. We've got to make it happen in the back here. All of you guys standing around the middle, around the scaffoldings there, that's right, you guys standing right there, you got to help us out here. On the count of three let's try it one more time. Everybody. One! Two! Three! Step back! . . . . We're not too f-----g great eh? Come on, one more time. I know that you can count to three and you're not stupid. One! Two! Three! Move back!"

This series of announcements, like the first series he gave earlier, had little effect. There was no large-scale, simultaneous stepping back at the count of three. The change in density was quite small in the most crowded section (labelled 1 on Figure 1) where there was less than 0.2 square metre (2 square feet) for each person. If there had been 3 metres (10 feet) of movement to the back here (and this is unlikely) each person's area would only have been enlarged by between 10 and 20 percent. This might be enough to reduce significantly the chance of injury.

The tape recording for the above transcript was made in the press box high above the crowd. Within the crowd itself there was a great deal of noise, making the announcements even more difficult to hear clearly. Respect for the announcer and clear announcements are needed for such crowd control measures to work. The announcer not from the radio station had more rapport with the audience and was more successful in moving people back. Later in the evening, someone from the group The Who asked the crowd to move two steps backwards. This had some effect.

During and shortly after the break between the third rock group, Heart, and the final group, The Who, the aisle stairs and the cross aisles in the newer grandstand on the south side of the field were filled with people. Looking across the field it was difficult to detect where the aisles were. The area appeared to be one undivided mass of people. This did not mean that this grandstand was fully occupied. Apparently many people who should have been in the grandstand were on the field adding to the pressures there. (An estimate of the number of people in the grandstands was made at 0:00 and this is discussed below.)

CONDITIONS AT 22:40, WHEN THE WHO BEGAN PERFORMING

The wave phenomenon signifying extreme crowd density, that was noticeable during the previous group's performance, was occurring again in the area within

approximately 12 metres (40 feet) of the stage. It may well have been that any small reduction in density that was achieved with the small steps back during the break was reversed as people again crowded closer to the stage. The density on the field appeared to be more uniform than it was earlier (as noted under the conditions at 21:00) and at this time it may have been occupied by as many as 35,000 persons. This condition continued until around 00:00.

CONDITIONS AT 00:00

At this time some people started to leave. The grandstands were estimated to have the following occupancies: north and south side grandstands were 75 percent to 90 percent full (including the largely empty areas beside the stage). The far end grandstand to the west, over 150 metres (500 feet) from the stage, was about 40 percent full. This estimate suggests that at their most crowded condition the grandstands held 35,000 to 40,000 persons while the field held approximately 30,000 to 35,000 persons with a total audience size of approximately 70,000 persons. (At 21:00 the field had been estimated to have approximately 31,000 persons on it.)

CONDITIONS AT 00:20, AS THE WHO BEGAN ENCORE

Toward the end of their main performance and just before the encore there was more obvious egress flow from the field and the grandstands. Many from the north corner of the field, near the stage, used an aisle in the north grandstand to leave. At this time the aisle carried a maximum flow of approximately one person per second. Gate A, the main entry to the field, was also used for egress from the field. These egress flows almost stopped when The Who reappeared for the encore but picked up again a few minutes later.

The average total flow from the stadium could easily have been as high as two hundred persons per minute during the 20 minutes preceding the encore and three hundred per minute during the next 28 minutes of the show which ended at 00:48. Thus the population in the stadium at the concert's end could have been down to between 55,000 and 60,000. The crowd density in the field area behind the lighting towers was considerably reduced during the encore. The field population could have been down to fewer than 25,000 at the end of the concert.

EGRESS CONDITIONS AT THE END OF THE CONCERT AT 00:48

At the end of the concert patrons on the field attempted to leave via three main routes, in addition to the grandstands' aisles and vomitories.

> Gate A, the main entry gate for many of people on the field, had a width of 9.1 metres (30 feet). Beside it was an egress gate with a width of 7.3 metres (24 feet). The route to both gates narrowed to approximately 15 metres (50 feet) between grandstands.
>
> Gate 2, with a width of 6.1 metres (20 feet), was reached via a route north of the stage with access through a 5.5-metre (18-foot) gap in baracades.

> The third (potential) route, to a gate 6.7 metres (22 feet) wide, was located southeast of the stage and was narrowed to approximately 5.5 metres (18 feet) beside the stage (Figure 4).

The route to the north of the stage was opened immediately when the concert ended and barricades prevented people from getting into the backstage area. The route to the southeast of the stage was never opened. It is unlikely that the concert organizers would allow its use because egressing patrons would then move between the stage and dressing rooms as well as going through a barbeque area with a tent set up apparently for a post-show party. Several minutes passed before many patrons, waiting for barricades to be removed here, realized the route was not available and they moved to other egress routes.

Intensive movement through the barricade opening to the north of the stage lasted for approximately 6 minutes. The route's capacity is estimated to be approximately 600 persons per minute for the young able-bodied patrons at this event. It is thus estimated to have been the egress route for about 3600 persons during the first 6 minutes of egress.

This north route had defects that compounded the problem of lack of familiarity by patrons. One of the large floodlights used in the light show was parked in this route. The walking surface was somewhat poor due to cables and other material on the ground. Lighting was relatively poor. The main field lights which added a lot of light to the field and surrounding areas did not come on until nearly seven minutes after the end of the show. When this egress route first became available at the end of the rock concert someone collapsed in the middle of the dark egress path. Quick-acting security personnel pulled the person out of the way of the crowd which followed.

The largest entry and egress route, between the old and new grandstands at the west corner of the field, provided a capacity estimated to be about 2000 persons per minute for the young able-bodied people present on the field. It was extensively used for about 11 minutes by as many as 22,000 persons.

In the new south grandstand the cross aisle took about 8 minutes to clear (except for stragglers). The older grandstand on the north side was not entirely visible from the press box overhead and its egress was not documented; however it likely was clear within the same time as the new grandstand.

These egress times are quite good but not surprising considering the nature of the crowd which was composed predominantly of young and relatively fit people. Despite the widespread use of drugs and marijuana, with a very small amount of alcohol (the effect of which would have been small later in the concert), there was little evidence of people being unsteady on their feet, weaving or needing assistance when leaving. The fact that many had been packed at very high densities during the preceding six hours or more may have meant that the usual relationships between density and flow perhaps did not apply here. Therefore the capacity flows estimated above could easily have been attained.

SUMMARY AND RECOMMENDATIONS

Although there were some flaws with the egress system (in terms of unavailable gates and relatively poor lighting in some areas) the biggest flaw to be rectified with future events of this kind is the lack of control of the number and distribution of patrons on the field. Those responsible for this event have much good fortune to thank for the absence of serious injuries or loss of life. Those managing the event appeared to be incapable of rectifying the crowd crush condition in front of the stage after they had failed to exercise control over the number of people congregating there.

It has already been pointed out that this arrangement, called "festival seating," is by no means seating. The word "festival" does not apply either. If the comfortable crowd densities observed in the field area around 16:00 could have been maintained somehow the term "festival seating" might apply. (See Figure 3.) At this density, with each person being able to sit with at least five square feet of area, the Exhibition Stadium field can comfortably hold 20,000 to 25,000 persons. There could be adequate space for circulation. Moreover, sightlines would be improved for all.

Some means must be found for limiting the number and density of persons immediately in front of the stage. Convenient circulation routes around that area should be maintained. A combination of design and management techniques might work here in conjunction with improved awareness by rock show audiences of the hazards of high crowd densities encountered during this show and found in tragic crowd incidents.

A design feature that apparently has been used successfully in rock concerts is an increased height for the stage so that anyone coming too close will not be able to see all the performers on the stage. A refinement might be to cantilever the forestage in such a way that any spectators who are pushed forward by those behind will simply end up in a circulation space under the stage instead of being crushed against a barrier or wall.

A crowd management technique that might be considered is to use closed-circuit television technology to help solve a classic problem in crowd crush situations, namely the lack of front to back communication. The people at the back have an inadequate idea of the trouble they are causing for their colleagues at the front. Here consideration might be given to displaying for those at the back a closed-circuit television image showing the conditions at the front. In other words, an attempt should be made to utilize patrons' concern for their fellows rather than their obedience of the instructions of authorities.

Lighting facilities permanently installed for general illumination, plus some of the complex temporary systems used for light shows accompanying the musical performances, could be used to advantage to help solve problems of crowd safety including crowd egress. Exit routes should not be left in relative darkness.

It is not within the scope of this report to list a large number of recommendations for improved crowd safety in events such as the observed rock

concert. A future larger report, to which the above observations may contribute, will perhaps include a comprehensive set of recommendations. Such reports may come from the current work of a committee set up by the International Association of Auditiorium Managers to examine crowd safety and management and to propose standards. One currently available set of recommendations is found in the report by the Task Force on Crowd Control and Safety set up by the City of Cincinnati following the tragic crowd incident at the rock concert on December 3, 1979 (7).

In conclusion it is worthwhile echoing one broad recommendation of the report by the City of Cincinnati Task Force. Public assembly facilities and events deserve more technical attention than has been seen to date. We must find out what design and operating measures work in such facilities and events, as well as finding out what does not work, if we are to maintain or improve the comfort and safety of the public. The observations reported above were organized on very short notice and they leave much to be desired by way of scope and precision. They are nonetheless significant if they are part of a larger effort to improve knowledge and technology of crowd safety.

ACKNOWLEDGEMENTS: Gratitude is expressed for the cooperation of management and staff of the City of Toronto Department of Buildings and Inspections, particularly Arnold Park, Ron Alderson and Werner Sommer who participated in field observations. Special thanks go to Werner Sommer who produced the Super-8 film record and with whom valuable discussions were held after the event. The cooperation of Exhibition Stadium management during and after the event is also acknowledged with thanks.

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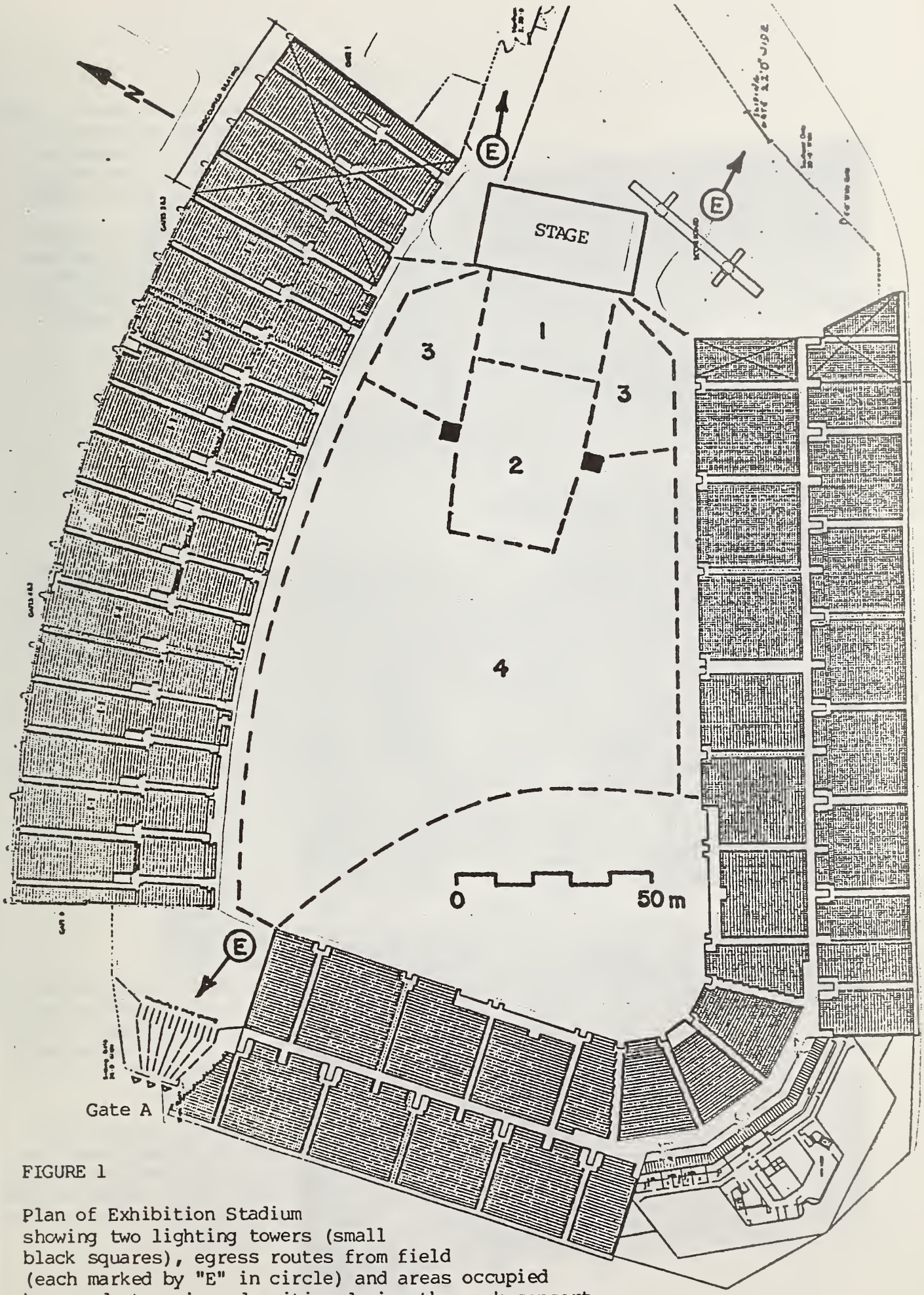

FIGURE 1

Plan of Exhibition Stadium showing two lighting towers (small black squares), egress routes from field (each marked by "E" in circle) and areas occupied by crowd at various densities during the rock concert.

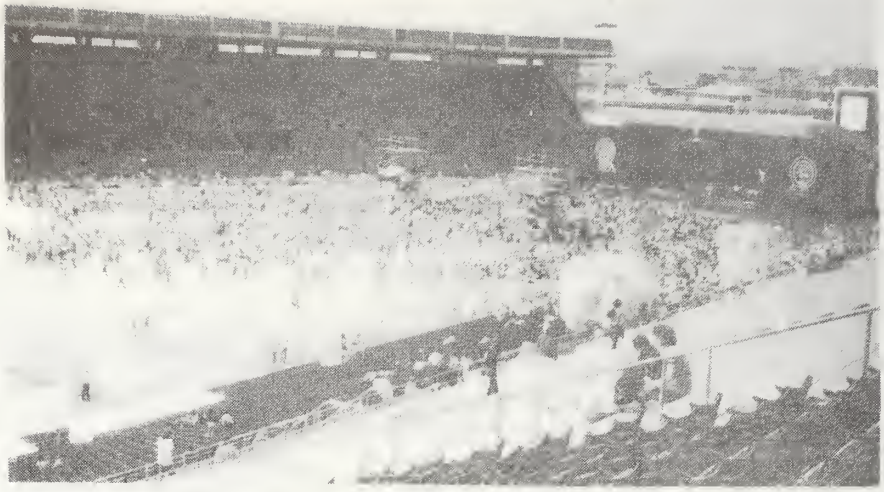

FIGURE 2

View from new south grandstand to stage and old north grandstand at about 16:00, two hours before the concert began.

The press box, from which most of the reported observations were conducted, extends across the roof of the north grandstand.

FIGURE 3

Two hours before the concert began people were able to sit at a comfortable density on the field which was covered with a tarpaulin protecting the artificial turf.

FIGURE 4

Peer security maintained a clear area separating the audience and stage (to the right, off the photograph) two hours before the concert began.

Barricades, blocking the southest egress route from the field, are shown at the lower right. These remained in place even at the end of the concert.

FIGURE 5

Toronto Star newspaper photograph, taken from the stage, shows the dangerously dense crowd condition that was maintained for up to seven hours. Cooling thirst-quenching water, frequently thrown by the bucket at these people, contributed to their unkempt appearance as the evening progressed.
(Photograph by John Mahler.)

SUPPLEMENTARY DISCUSSION ITEMS

Provided By

Dr. Irving Goldaber
Consultant on Social Conflict Management
and Crisis Intervention

and Special Consultant to the

Cincinnati Task Force on Crowd Control and Safety

** Architecture and Design: How can places of assembly be designed to improve the safety and efficiency with which places of assembly are entered, used, and exited? What architectural features or elements are in particular need of review?

** Arena Management: What aspects of arena management must be improved to increase safety in places of assembly? What should be the roles of ushering, security, and police personnel during theatrical and sports events?

** Psycho-Social Signals: To what extent do events "on the playing field" prompt mass behavior and crowd movement by spectators? How do psycho-social signals influence spectator safety?

** Educating Patrons of Theatrical and Sports Events: Can (and should) the general public be trained to enter, use, and leave places of assembly safely?

APPENDIX D

POSITION STATEMENTS

City of Cincinnati

OFFICE OF THE CITY MANAGER
CINCINNATI, OHIO 45202

April 30, 1981

Dr. Fred I. Stahl
Environmental Design Research Division
Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, D.C. 20234

Dear Dr. Stahl and Participants of the Ingress Workshop:

On behalf of the Cincinnati Task Force on Crowd Control and Safety and the City of Cincinnati, we would like to extend our support for the work you are undertaking.

During the many months of the Task Force research we became aware of the need for initiating new research in the field of crowd dynamics. We, therefore, recommended in Chapter IV "Architectural Planning and Design" of the Task Force report that:

1. The National Bureau of Standards should review existing regulations concerning pedestrian and crowd processing in, through and out of buildings, and embark on new studies directed at establishing new regulations where appropriate.

2. The National Bureau of Standards should initiate new research into the changing pedestrian flow patterns with emphasis on, but not limited to, high density rates, ingress flows, ticket processing, entrance configurations, the influence on environmental variables and crowd dynamics in high density situations.

We hope that the participants of the Ingress Workshop will be able to distill these general recommendations leaving particular areas and concerns for agencies like the National Bureau of Standards to address through research.

The benefits of such studies will serve the tens of millions of Americans that yearly attend carnivals, sporting events, concerts, parades and other activities where large assemblages of people are encouraged. Law enforcement agencies, facility operators, promoters and crowd management specialists overwhelmingly support the spirit and goal of this workshop. A sample survey of 15% of the

1300 recipients of the Task Force report in 35 states, the District of Columbia, and four provinces in Canada supports our belief. Ninety-two percent of those responding to our questionnaire agreed with our recommendations for new crowd research. There definitely is national support for what the Ingress Workshop is attempting to accomplish.

We believe that the recommendations that may be proposed by the Workshop can save lives and property in the future and generally make large public events more enjoyable. We are also aware that this effort may carry on past the one-day Ingress Workshop. Should this be the case, we will lend our support in any way that we can.

Sincerely,

David S. Mann
Mayor
City of Cincinnati

Sylvester Murray
City Manager
City of Cincinnati

Henry J. Sandman
Safety Director
University of Cincinnati
Chairperson - Task Force on
Crowd Control and Safety

Paul L. Wertheimer
Public Information Officer
City of Cincinnati
Chief of Staff - Task Force on
Crowd Control and Safety

International Association of Auditorium Managers
500 N. Michigan Avenue, Suite 1400 • Chicago, Illinois 60611 • 312/661-1700

April 28, 1981

Dr. Fred Stahl
Environmental Design Research
Division Center for Building Technology
National Engineering Laboratory
National Bureau of Standards
Washington, DC 20234

Dear Dr. Stahl:

The International Association of Auditorium Managers (IAAM) is the only association of professional public assembly facility managers. Our membership of 900 executives manage most of the major public assembly facilities in the U.S. as well as nine other countries including Australia, Canada, England, Mexico, Nigeria, the Republic of Panama, Sweden and West Germany. This includes 393 auditoriums, 361 arenas, 116 stadiums and 385 convention/exhibition halls.

As working professionals,we are aware that recent tragedies ranging from rock concerts to hotel fires have spurred much interest in and even more talk about legislating crowd safety. Many state and local legislatures have rushed to judgment, enacting crowd management and safety laws with more good intentions than actual knowledge of what is involved in effective crowd management.

IAAM has long taken the opposite position, preferring a realistic approach to evaluating and solving the problems stemming from crowd behavior in public assembly facilities. Thus we are extremely concerned that standardized legislation not be enacted to cover all types of facilities. Our cumulative, diverse experience indicates that there are many different types of facilities with significant differences in design, ingress/egress patterns, physical barriers, police and security personnel, ushers, ticket-takers and every other factor affecting crowd management.

Because of the nature of our work, IAAM members offer an immense amount of individual and collective experience in crowd behavior and management. When one considers the thousands upon thousands of events

held each year in the facilities we manage, the number of disturbances or incidents which occur is actually quite miniscule. However, when such an incident does happen, the numbers of people involved tend to focus public and governmental attention. The glare from this public spotlight can sometimes distort attempts to view the incident objectively. For example, because of what happened at the 1979 Who concert in Cincinnati, most of the legislative attention has been directed toward rock concerts. Yet, as any facility manager could tell you, the area with the greatest potential for crowd disasters is sports events.

Nevertheless, current sentiment leans toward passing legislation to ban specific practices such as festival seating (which would be ineffective in preventing such future tragedies) or toward broader legislation to enforce uniform crowd handling practices upon all facilities regardless of type or nature of events handled. The latter approach would actually create more crowd handling problems than it would solve. The audience in an arena for a rock concert differs greatly from that attending a hardware trade show in a convention hall. The crowd at a stadium for a hockey game differs greatly in temperament from the audience at a concert hall to hear a symphony. To attempt to deal with all of the many types of crowds which pass through our highly diverse facilities with one set of uniform, standardized crowd control legislation appears to us highly simplistic.

The key to understanding this concept is the term "crowd control." A park ranger from the Badlands National Park in South Dakota was describing a buffalo roundup to the editor of our IAAM publication, Auditorium News. When asked, "Where do you herd the buffalo?" the ranger replied, "Anywhere they want to go." The parallel is not meant facetiously. One does not control crowds because once they reach the point where they need controlling, it is not only impossible but it's already too late. What one can do--if we are professional enough--is to manage crowds. But this is done subjectively on a case by case basis. This requires not legislation but professional experience, training and judgment.

Thus IAAM feels that the rush by state and local governmental bodies to legislate crowd control methods is not only ineffective but, more significantly, one more sign of the deeper need for more intensive

research into this entire area. The last major study of crowd behavior was made in 1935 and then only considered crowd movement under normal conditions rather than under peak conditions where the need is greatest.

For this reason last July the IAAM board of directors authorized the appointment of an ad hoc "IAAM Study Group on Crowd Behavior and Management." Dr. Robert Sigholtz, manager of Washington's Starplex/Robert F. Kennedy Stadium and D.C. Armory, who is attending this meeting on my behalf, was named chairman, and Dr. Irving Goldaber, internationally known sociologist and crowd management consultant, is serving as an advisor.

Their preliminary report--titled "Spectators and Safety: The Development of Standards for and Their Implementation by Facility Executives"--served as the prospectus for a three-year program for the first major study of crowd behavior and management since the one in 1935. As a result of board approval of the Sigholtz and Goldaber proposal, the committee has been expanded to a five-person study group to pursue public and private funding for the project and to seek support from related areas. Already the IAAM project has created great interest among sports leagues, law enforcement agencies, insurance companies and other groups interested in public safety.

The third phase will involve a year-long intensive study seeking to develop a program operated by IAAM of safety certification of individuals in the crowd management field. Such a program is the real answer to the challenge laid down by the Cincinnati Task Force on Crowd Control and Safety: to develop and implement universal safety standards for crowd management. But it is also the culmination of more than five years of cooperation in the field of crowd behaviorial study between Dr. Goldaber and IAAM members like Dr. Sigholtz.

It is IAAM's hope that the study group's activities may serve to balance any hasty attempts to legislate controls which essentially should be management decisions made by professionals in the field. Ideally, safety should not interfere as much as is necessary. However, IAAM feels strongly that safety should not be an outside factor imposed upon an event but rather a professional necessity inherent in the nature and management of the event. If managers of public assembly facilities, with the cooperation of other interested parties, are allowed to develop their own professional program for crowd management, safety will not interfere with entertainment and entertainment will not interfere with safety.

Sincerely,

John W. Fearey
President, IAAM

JWF/ip
cc: John W. Lyons, Director
George Bohlinger, Acting Admn.
Dept. of Justice

POSITION STATEMENT

Every public assembly tragedy in the last fifty years reveals common traits of disaster. We act after the fact! In spite of blue ribbon panels and enactment of legislation, we have very little enforcement of codes or laws relating to actual procedures in Public Assembly.

There are municipal codes, County Disaster Plans, State Emergency programs for tornados, earthquakes, floods, hurricanes, and even plans for invasions of territories. We have carefully neglected the Public Assembly area for over fifty years, and through a step by step process we have backed ourselves into a cultural phase of poorly thoughtout procedures to govern the assemblage of the masses.

Behavioural studies have been funded and researched for specific movements of people at popular Public Assembly areas. There is the pre- World War II film produced by the neo Nazi, Hitler regime, about experiments with youth in Public Assembly facilities, related to panic. Walt Disney instituted studies before some of his famous parks were opened. Mr. Ben Schlanger of New York City, assembled material about crowd control in the 1960's. Dr. Quatranelli of Ohio State University has researched crowd control and panic. The Office of Strategic Services, OSS, during World War II, instituted a number of studies about terrorists, crowd control, and mass panic. Dr. Irving Goldlaber, present here, has labored long in his work with the Center for Crowd and Spectator Behaviour. My own experience has been related to Public Assembly and the Entertainment Industry for longer than I care to admit.

It seems to me that we are here to address a number of behavioural

patterns in our culture. People's natures have not changed in the billions of years, they have adapted to the culture of the times, which they inform. Perhaps they are more motivated and susceptible to violence today. Perhaps. In my attendance at hundreds of Public Assembly functions per year, I perceive the same groups that echoed in the Roman Coliseum, but in a more frenzied fashion. I believe that frenzy is activated by other causes and forces, i.e. drugs and alcohol. There are other motivating factors as well, but I believe the above substances raise the level of frenzy.

Attendant upon this behaviour are the Public Assembly structures and areas of assemblage. Too many of these structures, aesthetically may be pleasing to the eye, but have been designed to mass large groups of people, or small groups, and have not given attention to the well-being of these people in body and in movement. These movements are the stuff of ingress and exiting. This seating is also the bread and butter of each facilities fiscal health, but not the safety and health of the patrons.

Our charge then is to examine the aberrated behaviour as it interfaces with the structures. If we add the untrained personnel, the lack of management in crowd control, the ill defined security features, and the stimulants, we have sufficient cause for new studies, research, and guidelines.

Therefore, we should inquire as to certain areas of information, and our task will be to design the matrix for that information and place it in such a synthesis that it will be applicable to all Public Assembly

situations, and can be readily tailored to the control of definitive risks in each locale and structure.

1. What information exists? What studies and research have been done and how relevant is it to the problems of ingress?

2. Specific efforts should be made to document, through incident and media, existing design deficiencies. This is a long task, but I believe necessary to the final study.

3. Isolate all management practices, through incidents and through documents. Actual practices, philosophy and procedures have been ill conceived and egregiously initiated.

4. Dual factors of egress and ingress must be correlated. Recent night club and hotel fires have pinpointed errors in the codes and their enforcements in this regard.

5. All requirements for entrances, local, national, and international should be examined. European standards do not key with ours.

6. Education, instruction, and training should be examined, developed, and a system for its mass propogation should be carefully pondered. The methods in public and private enterprise do exist for this function.

7. Technological data, with design parameters should be part of all design functions, and detailed recommendations should be supported by architectural and construction organizations. (We recognize the blind and the handicapped situations, by law and by structure. Equitability should apply in all cases.)

The class play, the ZOO STORY, by the playwright, Edward Albee, gives great insight into the behavioural climate of our times. It poignantly illustrates personal confrontation with public seating. Perhaps the perusual of this small tome might be suggested to those who, by position and by organization, make decisions with the powers that be, for movement of people in Public Assembly areas.

Dr. Randall W.A. Davidson,
Public Assembly and Entertainment Industry Consultant
May 4, 1981

Forethought As Basic Rule Of Crowd Control; Wisdom Dictates Strong Panic-Prevention

By RANDALL DAVIDSON

(National Commissioner For Health & Safety U.S. Institute For Theatre Technology)

"Advance-planning" is the key ingredient (if often all too rare) in all types of crowd control, ranging from Mardi Gras parades to California Jam, up to local disco operations and political gatherings.

Every facet of every operation must be carefully planned and plotted, for each individual event. (The Saturday morning parade may be entirely different from an afternoon or evening one). Similarly, in any public assembly event, crowds vary from locale to locale, group to group (depending upon the appeal of the event and who it is slanted toward, i.e., music, rock, industrial, political, Olympic meets, parades, large funerals, animal shows and festivals.

The list of types of events is legion, but all most follow a common philosophy when it comes to planning for safety. There are major considerations and ground rules to be scrupulously followed and complied with, in order to ensure true and constant control of all acceptable risks in Entertainment and public assembly.

The 'Kind' Of Audience Needs To Be Considered

Specific principles must always be used in developing the plan for potential crowd control. I say potential, because in the first place, we are expecting an audience of specific types of people with specific kinds of behavior, but more and more, we plan for "crowds" rather than audiences.

Crowds are groups of people motivated by "emotional" rather than "rational" thining. The emotions are translated into emotional or irrational behavior, i.e., the sale of 10:00 A.M. at Jake's Department Store; limited, 100 items; auctions, concerts, lining-up for the theatre, soccer games!

We are dealing with momentum! The sheer, physical mass of bodies surging in one or nearly one direction, with but a single goal. I am sure you can fathom-up untold instances of European and Latin American soccer games, other athletic events (end of a series or tournament), fire, flood, earthquake, appearance of a famous person or star or idol, which deal directly with masses of people.

Every public assembly event has a purpose. Whether it is motivated by good or evil, is not the question here. The purpose is usually obvious: a sale of some item, a performance, a display of philosophy, a patriotic meeting, the Olympics, a conference, parade, bingo, what have you.

Even Funerals Definitely Require Crowd Control

Some public assembly gatherings are commercial, amateur, voluntary public or private. Each event attracts a specific type of person, depending upon the event. Each event is planne , for a specific locale or in a specific physical structure. Every event has its followers — yes, even funerals. (Remember the Rudolph Valentino "riot"). Each locale or physical structure has its specific architectural or material designs and limitations or barriers.

Some events, of a public assembly nature, do not conform to space parameters, inside or outside, with a specific type or size of audience or participants. Today, this is becoming the norm in the public assembly area. It is not a matter of standing room only — but of economics. ECONOMICS — how many bodies, at a given price can I manage to get into a give space?

(We understand there are "capacity" designations and numbers of seats, etc.). The consideration is ECONOMICS, i.e., profit, staying open, paying the rent, as well as performers; covering the bills; accommodating the producer or house; fudging on capacity; providing the "audience" what they want in spite of regulations: fire, safety, health. Something that seemed reasonable at the time — or in the back of one's mind — or just "don't give a damn," pack 'em in. Some type of reflection or thinking, perhaps, occurred before the event or booking.

Sky-As-The-Limit, As In Woodstock

An event, a city, a building or locale, a booking, an opportunity, numbers of people, and profit. (Economics) must all gel in order to fulfill a public assembly event.

Where does one go from there, in thinking of large groups of people? Physical facilities falls logically into place.

Facilities: Design of the building or buildings is an important industry today in our culture. As we grow in entertainment functions, we also are growing in size of facility. Some of our structures hold over 100,000 people, and in the case of outdoor events, only the sky is the limit, a la Woodstock. What does one do? Part of the problem and solution rests squarely upon the designer of the building. We are to hope and believe that the structure into which we walk, paying well to do so, is free of physical hazards. Into this structure individuals of all ages, sizes, intelligence, races, creeds, and states of health, will enter. Their goals, for a fee, is a common one — to be entertained, totally. The structure is at their mercy. "I paid my money — I have a right" — can be heard like a tape loop — over and over again. It is in this philosophy this attitude that the nurturing of the unique "crowd — complex or behavior" begins.

State Of Mind Of Those Who Paid Their Admission

One individual is joined by another, and another — like flotsam on a decadent lake. Their "rights" are beyond any accountability to a structure of those who own and manage it, much less those whose funds (hard earned) erected an care for this facility. For several dozen years — even to the Coliseum of the Roman times — we hear the raucous cries of "my rights" and "entertain me."

Forged by one will, all else fades into oblivion. Perhaps, as I have viewed it three or four hundred times, the unity (strange word in this context) of will, is fueled by other substances, other than desire.

The entire world of drug-highs and alcohol enter into this scene. The crowd of individual, desperate people, now is cajoled by inner monsters seeking "their way" — and "they will have their way."

Ants, Rabbits And Domino Theory — What Price Panic?

Restrictive parameters (gates, turn-stiles, doors walls, locked areas) become barriers to surmount. The entertainment function, the leisure time activity now turns into melee. The ant-domino-rabbit theory plunks right into modernizing. Follow me! All architectural designs fail — unless fortress-like they have used Lexan (safety glass), bars, steel locks and chains, metal doors and sealed entrances.

One frets about the crowd — in large or small quarters — the one bull in the china shop — becoming a herd.

I recall fire drills — in which silence was mandated and single file — until, coming down the stairs, someone pushed or tripped — and down we went. We stomped on several people before the line could stop — luckily only a pair of glasses and a split lip ensued. Panic.

We tried in England an experiment with crowds. One hundred fire men in a hall. All doors had panic bars. We all knew what we were going to do. Evacuate the hall — pell mell. At a given moment, someone yelled "fire" — and we all ran out the legal, required, width and number of exits. Only 18 were hurt — smashed against the side doors.

Sober, intelligent, legal requirements, knowledgeable, broad daylight — et al, and still we hurt ourselves. Not sufficient number of doors, and not sufficiently wide (units) for the capacity of the hall — but legal and sufficient under normal circumstances.

NORMAL circumstances. Not usually your public assembly situation.

Christmas crowds — final items — little time — you join the crowd everytime. The trolley car in San Francisco — the subway — any group, can become a crowd.

Perhaps we can remedy the architectural designs — zero barriers — wide enough — nothing to get hung on or impaled by, what then?

Tripping and slipping — places — all smoothed out.

The Behavior Symptoms Which Often Mark Crowds

What do we do with the crowd now? It is a crowd you know — (1) noisy, (2) boisterous, (3) single purpose, (4) deep desire for a common cause, (5) fueled by exotic substances, (4) deep desire for a common cause, (6) cardio vascular system receiving adrenalin at a super rate, (7) packed tightly together (8) exhuding perspiration, (9) on their feet for a lengthy period of time, (10) anonymous by virtue of the locale, (11) stimulated by the weather — hot or cold (either one stoking their personal furnace), (12) the excitement of the moment — moments of expectancy, (13) perhaps a total crowd feeling of deprivation, either real or believed, but whether young or old, — held back from a "seeable" or "hearable" goal — only meters away, (14) needed and cajoled by sound, voices, touch, fears, all surfacing and welded into a common cause of immediate satisfaction, (15) perhaps a tang of sexuality, and (16) maybe even hope that ahead lies some respite to what they are enduring now. "Adult? Child? Man? Woman? Anyone! A little lower than the angels" — a crowd ain't. It reminds one of Albee's "Zoo Story" — with the taunting over the bench. Two adults.

I recall a comment made in a "crowd" in a very conservative corner of America, when I notified them that President John Kennedy has just been assassinated. "Who cares?" I was stunned. Just as stunned as when I see the "crowd" pushing each other out of church to be first for the parking lot. Just as stunned as when I see the tearing down of the proverbial goal posts, or the crowds at Three River Stadium.

So — besides architecturally, well-designed spaces, for crowds to rage in, we need to know all the above items that make them tick. Because we must make more than fauning gestures at controlling them. We must exert our will on them (the crowd) in such a fashion as to modify their behavior and control it, to prevent injuries, serious or fatal.

Recall Sinatra Idolatry Of Times Square That Was

I remember the crowds in New York City in the 40's — all lined up in the street to get in the Paramount to see Woody and Sinatra. In the rain yet. Orderly. Six to seven hours. Finally inside, up the tiers of balconies — orderly — to a seat. Only the girls were throwing themselves off the balconies in oblivious rapture — but not many. Screaming yes — but semi-orderly. And only a few users to control us. Whew!

A crowd — a mob — all illustrate animalistic tendencies. Trapped — we fight. Wounded — we go for the juggler vein. At least we can leash animals — and cage them. Humans are different. If we cannot provide sufficiently strong, well-planned physical barriers, then we have to find alternative means.

Physical barriers are just a drop in the bucket. It goes back to planning buildings, yes, but to an entire pre-planning of our total approach to people and those special people who frequent whatever events we produce, sponsor, or manage.

Hints on Procedures

1. We must set the guidelines, and do so in a realistic manner.

2. Know from experience — what size group we expect — from years before, experience, ticket sales and advance hype.

3. Physical hazards must be removed, whether it is a table, a lamp, a door — whatever. Do not remove safety barriers.

4. Continually post graphic guidelines for all to see.

5. Be sensitive to the needs of the people coming to the event — i.e., parade, ball game, race, concert.

6. Post all regulations: few but exact.

Staff Training

7. All personnel who are ushering or in security or hawking food, etc. need to be trained in handling large groups.

8. Training of total personnel for all events is necessary.

9. Ascertain needs of personnel and number sin each facility.

10. Rigorously apply your well-thought out safety and health standards, geared to each event.

11. Don't wait for a number of incidents. Firmly handle each one immediately. The sooner you take control — the sooner you calm or alert others to what action and sancuons will be taken. (Nightclubs, skating, games, wherever).

Avoid Long Queues

12. Break-up the long lines of people, if possible. This relieves anxiety and pushing to some extent.

13. Sufficient exits or entrances carefully manned — perhaps two to three people — no blocking hazards.

14. Do not got by width of legal limit — It is better to have wider doors — special — than costs of injuries (just in case).

15. Remember planning dictated numbers of ushers and security personnel.

16. Emergency procedures: known to all trained personnel.

Knowingness

17. A definitive person in charge known to all.

18. A definite means of communications so you know what is going on at all times.

19. Knowledgeable in first aid (recommended first aid personnel be there — as at many games) depending upon size of crowd and inside or outside attendance.

20. Knowledge and communication means to get specific help.

21. All part-time or alternative personnel must be trained. (Only use trained personnel).

22. Meetings to discuss all eventualities based on prior and present knowledge of groups. (Usual customers, college audience, teenagers — ladies day at the races, etc.).

23. All risks must be examined. (Influence of event or performers or sports, on audience).

24. Riot equipment (flashlight, fire extinguishers, etc.) must be checked and in good order.

25. Decor must be such as not to impede passageways.

26. Well-lighted facilities.

No Smoking

27. No smoking by personnel — (fire and hazard danger).

28. CPR training useful.

29. Defuse incidents quickly by trained assessment and sufficient numbers of security people.

30. No weapons used, unless life is threatened.

31. One person in charge — without equivocation and exact knowledge of hwo to report incidents.

32. Timing of events is crucial — allowing one to defuse confrontation situations.

33. Use regulations that can be enforced.

34. No bottles or cans inside large events. (Clubs, discos, limit numbers of items and clean-up quickly.

Keep Promises

35. Don't promise opening time for play, performance, ballet, show — if you can't deliver. Keep in close touch with audience.

36. Examine attendance policy.

(Continued on page 70)

Crowd Control

(Continued from page 17)

37. Examine when entertainment facility is to open — who is to be there and what reporting is to be done about conditions — from a disco to a high school auditorium.

38. Co-ordinate all personnel from maitre to usher.

39. Review all fire codes, Life Safety Codes, Electrical Codes, dealing with your facility. Ascertain how many people necessary to enforce them at each event. Be accurate.

The key to Crowd Control and Risk Management is planning! — planning! — planning! All eventualities must be considered by all. Each event is a new event. Don't always judge by past situations. Small or large, adult or teen, crowds can be controlled with the correct planning and support. Authority and management must be exercised. Behavior must and can be modified if a total plan is put into action and curried through.

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PUBLIC ASSEMBLY ACCIDENT COSTS

TOO OFTEN 'SAFETY LAST' IS RULE

By ROBERT J. LANDRY

"Safety Last" would be a more accurate description of an attitude all too common in the United States as regards thousands of public assembly sites. The longtime pious slogan, "Safety First," popularised after the notorious Iroquois Theatre Fire (600 dead) in Chicago in 1903, is frequently not respected either because safety costs too much, or inspection is lax, or the show must go on, or there never has been an accident and the risk of one is denied or ignored, or there is undue faith in "fire-proofing."

Fire is only the worst of the hazards. Falls loom large. Occasions of structural break are an insurance company dread. Public assembly, the legal definition of which embraces entertainment, professional, amateur, academic or church, counts in halls, arenas, lounges, barges, tents, grandstands, gymnasiums, discotheques, et al. An average of four deaths from accidents occur weekly. Liability from negligence or mishap is calculated at over $300,000,000 yearly. As regards churches there is the incredible detail that 11 of them burn down every day.

The above paragraphs represent a mere sampling of quite grim data on safety carelessness and mindlessness supplied *Variety* by Dr. R.W. A. Davidson, president of the International Safety Institute of Erie, Pa. He is also Commissioner for Safety of the U.S. Institute for Theatre Technology, some of whose meetings have been reported in this weekly in recent years.

A certain amount of the Davidson evidence of entertainment site disasters is actually feedback from *Variety* itself, stories from all over. These range from high deficit mechanical failures like the bending of the revolving stage the very night the new Metropolitan Opera opened to a routine nosedive from that stage when tenor James McCracken tripped over a cumbersome costume. Reminders include the $750,000 fire at Detroit's second largest cafe, Lofy's; a girl fan crushed to death by the crowd at a David Cassidy concert in England. Or the Port Chester, N.Y. tragedy (24 youths dead) at a firetrap disco. Or a 15-ton "flotable" ceiling at the San Jose (Calif.) Community Theatre collapsing, with two stage riggers left dangling 60 feet above the main floor.

A failure of safety may only be the risk to toes and ankles of dancers on a concrete-hard stage floor as recently at the brand-new Minskoff Theatre in Manhattan during the run of "Irene," with Actors Equity protesting at first and then threatening to close the show to protect its members. A risk to singers vocal chords from clouds of dust drew complaint not long ago everytime stagehands moved flats for a musical comedy playing in an antique Philadelphia playhouse. There was the horror at Ridgecrest, Calif. when a "blank" bullet killed a amateur actor. In Paramus (N.J.) at the high school, equipage from the stage loft dropped on 400 massed singers.

Due notoriety in recent times has focussed upon the PCV element (Poly Vinyl Chloride) used in the pressing of phonograph disks and medically suspect as peculiarly liable to encourage cancer in the liver of workers.

On the unique side, though not entirely so, was a law suit in Maryland, parents of a 10-year old girl charging that the seats in a film theatre were vermin-infested and that the child picked up Rocky Mountain Fever ticks. Safety problems are of all kinds and degrees of liability. Just now a union in Hollywood is agitating against a film lab accused of excessive and insufficiently protected use of toxic chemicals, with a suspicion of cancer inducement. Accidents to crew members in shooting outdoor action risk scenes are well known.

Past Much Worse

Probably it remains true that cafe and theatre fires (not forgetting hotels) are well up on the list of tragedies. Theatre fires were of course almost an everyday hazard in the 19th Century first with candles, then oil, then gaslight. There is the classic case of the Bowery Theatre which burned down seven times, yet the final structure managed to exist safely for 40 years. But all that is history. Relatively stringent fire department regulations nowadays prevail. Even so, a woman has recently complained that the top shelf of a New York legitimate playhouse had locked its fire escape, a charge vigorously denied by the owners, since it would be serious indeed, if proved. It was locked fire exits at Klaw & Erlanger's Iroquois that resulted in most of the deaths by panic and pile-up.

Too Little Aware?

What is being done to minimize accidents in entertainment industries or public assembly points? Far too little, thinks Davidson. He comments that it's a slow-go because so often added costs are feared, or long-pull budget increase is needed and dreaded. Against which he shakes his head over the deaths and hospital expenses, the insurance premiums rise that result.

Davidson jeers at the do-nothingism implicit in such typical rejoiners as "The rigging system has always been adequate, so why worry about it?" or, even more dramatic in evil omen, "The lighting instruments have always been hung by the curtains and they haven't caught fire yet."

Davidson cites a note from a professor about a tragedy at the U. of Illinois, to wit: "A boy, focussing lighting instrument in the dark on the studio theatre grid, fell off, struck a batten half way down and broke his back. There is no safety rail on the edge of the grid."

News of concert shell fallings, I-beam bendings, noxious solvents emitting fumes in theatre workshops,, musicians electrocuted by their own guitars, Ann-Margret a mass of broken bones and bruises through a backstage cafe gear failure. The enormous compilation of small, medium and major disasters in public assembly situations is, says Davidson, "enough to raise the hair (and profit instincts) on undertakers."

THEME-PARKS: BIG ON HAZARDS, BIG ON SAFETY

Theme-Parks have entertainment for the entire family. There is something at every Theme-Park for all age groups. This year the Theme-Parks expect over 60 million customers, one-fourth of the population of the United States. One Theme-Park indicates they will be seeing 10 million Americans and visitors at their park, this year.

Each Theme-Park is like a city unto itself. Their territory ranges from under 100 acres to over 2100 for some of the large Theme-Parks. They are the largest form of regional entertainment and they are growing and they are expanding. Each year there are additional facilities, new rides and more personnel. Contrary to national rumors, there are a dozen which are in the drawing board stage and four more being built. THEME-Parks are big business. Big business is organized to make a profit. In order to make a profit, business must not have liability suits, breakdowns, poor images and ill-trained personnel. Theme-Parks run a tight show. Only one this last year converted to another type of similar operation.

As in all entertainment of such a vast scope plus the utilization of the wide sprectrum of rides and personnel, there can be a multiplicity of hazards. Theme-Park founders take this into consideration when they hire personnel and firms to design and build these gigantic entertainment meccas. Every facet of the park is scrutinized for safety and health problems. In some of the Theme-Parks, 80,000 people move through in a single day and this number is increasing. With this amount of customers, nothing can be left to chance where it comes to

the health and safety of the customer, performers and other technical personnel. Consider carefully, those who are interested in pursuing this type of occupation or career, the massive operation a Theme-Park is. Because the appeal is universal, that is, fantasy, historical, fun and thrills, all levels of participation are possible, all ages attend, and all types of entertainment must be planned and designed for these differences.

The differences apply to the employees as well. They also apply to the performers. Permanent staff and seasonal staff. Permanent entertainers and performers and groups who come for a week at a time. It is these settings, these thousands of customers and hundreds of technicains and performers which we must examine carefully in light of health and safety regulations.

All of the Theme-Parks are subject to Federal Safety and Health Regulations (OSHA). There are movements toward simplification of the OSHA application to Industry and a definite thrust toward aiding those who come under its jurisdiction. It would be an exemplary study for all who work in Theme-Parks to familiarize themselves with the small OSHA handbooks which can be ordered or purchased at regional Federal offices or Bookstores. Remember, OSHA (Occupational Safety and Health Administration or Act) has as its aim, the protection of the employee. If the tools, venilation, surfaces, restrooms, equipment, shoes, etc. are dangerous to the employee, OSHA is highly interested and by law can visit the Theme- Park and examine the milieu within which the employee, technician and performer, manager, etc. work. They can, with court help, cite unsafe situations and practices, and enforce

those Federal Statutes which apply to the worker and his environment. The Consumer Product Safety Commission also has a stake in the Theme-Parks. Equipment. Big equipment, small equipment, exotic equipment. The strict-liability law, upheld in the courts of the land, applies to all areas and equipment in the Theme-Parks, be it A defect in the product, be it a 135 ton moving piece of entertainment or a small rifle used in the games section of some parks. Adequate warnings must be present and enforced and reinforced to the customer and employee. Negligence must be proved, but the plaintiff need no longer prove the manufacturer was negligent, and he can collect a sizeable sum even if the product was used negligently. There is new legislation to clarify "product safety" but the awards from courts, seem to favor the injured person or persons. The Commission covers: the Flammable Fabrics Act, the Hazardous Substance Act, the Poison Prevention Act, etc. Some of these apply to possible hazards at Theme-Parks. There are civil and criminal penalties for violations.

Theme-Parks also come under the jurisdiction of State and local regulations and ordinances. In some States, the Agricultural Agency takes care of the Health and Safety, in other it is the Industrial Relations Department, in others the Industrial Hygience Department, Occupational Hazards Divisions, etc. It is important to know which regulatory agency your area falls under. In some areas, you also come under the County Health Department and city Fire Laws. It is a complex maze of regulations, but once understood, and enforced, very capable of aiding in the control of hazards and prevention of accidents among employees, performers and customers.

Remember, it is the health and safety situations and procedures which officials are concerned about. State inspectors, by law, are supposed to inspect these large installations at least once per year. This is deemed sufficient because of the highly regarded safety and health regulations and maintenance utilized by the Theme-Parks on a day to day basis. Certainly, employees have a right to complain to these officials and to be certain that confidentiality is kept. If an instance should occur which you believe is not being solved by your employer, after what you consider enough requests, notify OSHA or the State or local officials. Request confidentiality. Keep strict records of your incident or incidents, those involved, the situation or procedure, injuries, dates, times, witnesses, names, and pictures, if at all possible. Protect yourself. Keep several copies of your documentation, with its presentation and disposition material.

In most cases, where there are problems in the Theme-Parks they can be solved with the management. They are not anxious for injuries, accidents, loss of image, undue publicity or liability suits, or shutting down of rides and equipment. Be truthful, firm, and document all you do. Your health and safety, and perhaps others, are part of this concern. Remember, equipment is made and operated by humans, and there can be breakdowns, even in the most perfect of situations. There are records of suits, some still going on, in major Theme-Parks, so don't be bashful, if you believe your health or safety are in the balance.

In some States, amusement and Theme-Parks come under "elevator laws." Permits are issued after inspections, on the basis of each ride, and a seal or official sticker is attached after an inspection of the total ride. Structural components, wire rope, electrical connections and attachments, limit switches, seals, special safety devices and safeguards for the operator and the customers are looked at carefully.

If all of this does not seem enough, in line with safety inpsections, there is usually the maintenance crew in the evening, after the Park is shut down, who inspect, check, lubricate and run the rides, and other possible hazard items, each day. They are then tagged, in order that the morning attendants can again check and run the rides and look at the total park facilities. Only then, are they ready to begin another day of involvement with the customers. This type of check and double-check reduces all accidents and injuries. These added precautions, diligence and safety procedures are adhered to with regularity and rigidity.

Management must consider all aspects of safety when expanding the facilities, rides and personnel, especially when these have gone beyond the original safety capacities. Parking areas, dressing rooms, exits, numbers of extinguishers, entrances, all must be adjusted and the safety factors designed in.

A few types of Amusement Parks have become Theme-Parks, and facilities which have been antiquated and are being renovated, should be brought up to the present Life Safety Code, the recent National Electrical Code and all pertinent Fire Laws. In this respect, careful consideration must be given to vehicle capacities and access, pedestrian

access, concourses, sizes of bridges, showareas, storage capcities, food and refreshment areas, shoping areas, exits to and from existting rest rooms and to restricted areas.

For the person who is going to work at a Theme-Park, there are a great many considerations. 1. The number of people the park is going to have as paying customers. Large parks have upwards of 25,000 customers per hour on rides (in total) and seeing shows; 2. The age levels of the customers. Babes in arms to parents with strollers, to elderly people and to handicapped customers, with wheelchairs, canes, hearing aids, seeing eye dogs. Large families moving through the park together and some of the youngsters dragging their parents to each ride, as well as many teenagers looking for high excitement. These people come for a good time and are excited. The Theme-Parks purpose is to provide adventure, thrills and excitement so the customer will get his money's worth. Precautions must be taken, beforehand to control all the forces which are unleashed in this milieu of constant energy and merrimaking. The attendants and all who operate the park must be on the alert every waking moment in order to ensure at all times the health and safety of the customer. 3. The personal discipline necessary to work with large groups of such age diversity and who have paid for their enjoyment, and over such a long period of the day. 4. The rides and shows are repeated over and over again, and a high level of professionalism and technical expertise must be achieved and kept, each and every time. The employee is the key factor in the relationship between the Theme-Park and the customer. It follows, therefore, that the selection and training of the person who chooses to and is chosen to work at the Theme-Parks, must

be of the highest quality.

Who are chosen or selected? Technicians of every stripe: mechanics, engineers, attendants, supervisors, managers, lighting personnel, and staging personnel of many types. Although there is training for many of the full time and seasonal workers, it is necessary to select from qualified and skilled personnel to begin with.1)The individual must be mature, alert, thoughtful, responsible and persona ble;2) The person must have training and be skilled in the area for which he or she applies; if that area be electrical, mechanical, computer or some type of engineering skill, professional records of that skill must be given;3)Performers must exhibit, via auditions or through agents (if name performers) that they possess the professional skills in their area of expertise, such as acting, singing, dancing, miming, etc. 4)Theme-Parks have numerous other positions of expertise, ranging from lumberjack to glassblowing.

The Park is a highly personal and technical mix and must have top flight personnel at all times.

The seasonal employee is hired in large numbers and give excellent. training. If the employee is staying-on, he is give additional training and refresher courses. A few Theme-Parks have their own college or training schools. Every moment of the training sessions gives emphasis to the fact that the employees must have as their policy, the health and safety of the customer. It is the foundation of their training.1. They are given hands-on training with all the areas they will operating. 2. They are taught the rudiments of first-aid and how to apply on-the-spot medical attention, until the first-aid station personnel can be summoned and arr ive to alleviate the situation. 3.The must know what to do in the case of heart attacks, seizures,

patrons that might fall, care of the handicapped and elderly; 4.The must know what to do if the ride they are attending suddenly stops and the riders are trapped (as in the case in May of 77, when a group of riders was stranded, up in the air, for the better part of eight hours, in 45 degree temperature).5. The must be able to be alert to persons they believe might cause problems, either on rides or in other entertainment areas, such as shows. 6. They must know the emergency plan for each ride they take care of or each show they work. 7. What to do in the case of lightning, a rain storm, an accident, are all part of the training for the attendant of rides. 8. Use of fire suppressant materials, should the case arise, and the speedy, calm evacuation of customers. 9. Hypervenilation, perhaps during a ride or Rock show, exhaustion and fatigue, obstreperous individuals, all comes under the aegis of the employee, and he or she is trained to cope with this with alacrity and with amazing tenderness. It is the attitude of the attendants and other personell which shows through at the Theme-Parks. Handling large crowds, in states of excitement, takes maturity and thorough training. Expect the unexpected, and it will occur. 10. They are taught to avoid monotony, and some parks switch people from different areas in order to keep down this danger. The attendant must always be super-alert. 11. If a ride or some other area of entertainment becomes inoperable during the day, they must know how to rope it off and isolate the area from the crowds. 12. Certainly, there is to be no smoking or drinking or snoozing on the job. 13. Personnel are expected to be in good physical shape and to be able to take high stress for long periods of time. This, of course, means the personnel must get proper nutrition and sleep.

The public demands are great and the Theme-Parks must meet them, via the entertainment and thrills it offers, and this is done through expertly trained personnel. It is the opinion of this author, that Disneyland has the edge on training and the application of health and safety, both for the customer and for the employee.

In high-stress situations like the Theme-Park, it is a good idea for the employee to have First-aid training, (CPR) Cardio Pulmonary Resuscitation, and other formal life-saving procedures. This will stand the employee in good stead both in and out of the work situation. The customer and the employee are both in a stress situation, one in high excitement and the other in stress from constant alertness and a high level of physical activity.

In one Theme_park, recently, I noticed roving employees, not attending the ride, constantly going back and forth and around the structure of one of the "white knuckler" roller coasters, and this practice kept up all afternoon. They indicated they were not looking for defects but only checking on the safety of the ride during operation. Three attendants were making sure the riders were safe and obeyed the regulations and the three other employees were checking the structure. That illustrates a high safety attitude on the part of the management. It is through this employee-customer contact, that one finds the philosophy and policy of the management in health and safety most noticeable.

Attendants and technicians are directed to observe carefully the enclosure fences which hou se the rides and hold back the audiences.

This is the sign of safety designed into a ride. The fences must be kept in good repair and the rules and regulations are posted and bellowed out carefully by attendants with speaker units. Railings are checked carefully, all bolts, straps and bars are checked constantly. ~~Some~~ ALL high thrill rides have safety engineered-in, such as two locks, one being an individual lock and the other a common lock, by electronics, for all the straps and bars. Some rides have dual checks, and two keys for locks, neither one being interchangeable.

Built into the systems are double protection: all over there are dual motors, should one give out; each ride has its own switches and limit switches and an emergency power sources; customer traffic is routed so that patrons getting off a ride do not conflict with those getting on; plexiglass is used where animals might possibly get to the customer or the customer to the animals; railings are full railings, so small children will not accidentally fall through; pets are checked in so that they will not cause any problems in the parks; refuse and sticky paper is picked up constantly, so no -one might slip; even parking lots come under the safety analysis: many Theme-Parks have the situation where you don't have to back up in the parking lot, only pull forward; special areas for campers and buses; non-slip concrete; structures are desisgned so the patrons, if they put arms or hands out, on rides, will not be able to touch anything and get hurt; as few stairs as possible and low ramps for the handicapped; and even though some boat or train rides might hold more, with safety ratios being considered, the number if often less on each ride, for the added safety.

Patrons have been known to be dizzy when getting of thrill rides, such as roller coaster, parachutes, etc., and the attendants must be alert to care for these customers.

The employee is considered at one park in a special way, in the food and refreshment area: money is sped to a central location via pneumatic tubes, to reduce the hazard of a possible robbery. There are many food and refreshment areas, and these must be kept clean. These areas feed thousands of people, all seemingly in a hurry, and the personnel who work here, must also be alert and calm, while being thoughtful and efficient. Hundreds of different types of foods, representing hundreds of ethnic groups and countries, are prepared each day. Refigerant units, eletrical units, all types of wiring, pastic ware of all kinds, and many, many utensils, must be taken care of, watching for wear and tear, chips, fraying, possible fire problems, and in certain climes, bugs. Constant attention must be given these areas and maintenance kept at a optimum, as in all the areas of the Theme-Parks. Cleaning and cleaning materials are to be part of the daily chores of these attractions. Cleaning materials must be stored carefully and used carefully. Hygienic practices are the order of the day, at all times. Inspectors from every area, are highly conscious of the food and refreshment operations.

The other area which is closely allied with the refreshment and food part of the park, is the souvenir and shopping part of the Theme-Park. Again, it is the careful observance of the treatment of the

customer which is important. The purchase and selling of souvenirs of all types is a a must for every park. It stands to reason, that safety must be built into the types of souvenirs which are sold. This area comes under the Consumer Product Safety Commission. All of the Theme-Parks which I visited over a two year period, have set high standards in quality, souvenir products. The souvenir is the memory of the Park which you take with you, or at least one physical memory, and it is wise that these items are produced as a safe souvenir. Personnel finding items to the contrary are advised to notify the management. They are only interested in good will in this souvenir business.

What of the performers? The live entertainment? Yes, and the places where they perform? Outdoors! Live gunfights. Aqua shows. Glass-blowing. Ice skating. Concerts. Dances. Gold mining. Train rides. Fire engines. Steamboat rides. Performers with animals. Canoes and rafts, row boats, other water craft. Horse and buggies and stagecoaches. Blacksmiths. Weavers. High wire aerialists. Actors in animal cartoon costumes. Theatre and mime acts of all kinds. Puppeteers. The list is long and it is varied, but involved in all of these performances are technicians, performers and places for them to work and perform. These areas hold their hazards as well, and must receive constant maintenance, repair, repainting, and the application of safety procedures.

The equipment these people use must be in first class shape. It is used often during the day, and day after day. Breakdowns are costly in terms of profit and in terms of morale and in terms of image. Quality equipment must be the first line of operation, and care must

be taken, each day, and each performance, that it works efficiently, and is safe for the technician and the performer. Remember, you are setting up a show, many times per day, in the evening, day in and day out. All physical areas, such as stairs, railing, ropes, wooden and metal surfaces must be free of hazards, both on walls and on walking surfaces. Performers move rapidly, and depend upon a good surface to do-their-thing-in.

Electrical equipment, such as lighting, follow spots, circuits, instruments dimmer boards, audio systems, winches, should be in first class shape. If it is not, report it, get it repaired and do so with alacrity. The health and safety of the technician and performer are at stake. All mechanical equipment, must likewise be checked and in running order, all of the time. Replacement of worn items, cleaning and lubing of winches, rigging systems, etc. should be mandatory. Entertainment spaces, theatres, clubs, in Theme- Parks are large, some as large as 6,000 seats. There are also intimate 400 to 2500 seat houses, and these need just as much care.

Be cognizant of possible tripping hazards, both in the auditoriums and foyers, as well as back stage. Make sure good housekeeping is observed in all performing areas. If flammable materials are used for repair or other applications, ensure everyone's safety, by storing them properly in an authorized cabinet. Check platforms for splinters, protusion of nails or loosening of bolts. All pressure tanks, gauges, dials, connections should be checked each day for possible leaks, loose connections or fittings. Unchecked situations

may lead to possible explosions. Many pressure tanks, including liquefied petroleum, such as propane, can explode if not carefully handled and cared-for, and such accidents are a too common occurence .

If there are many, many electrical and electronic appliances which are used, grounding is required by Code. Connections can come loose, wires can be frayed with such a deluge of shows, vibrations can cause loose connections, shorts can occur and fires can be caused by these defects in maintenance. Several Theme-Parks have had fires, in Theatres and other structures, from electrical causes. Check your systems often.

Entertainers must take care of their health. Fatigue and heat exhaustion do occur to performers. A lot of activity, hot lights, added performances, tension, etc. all contribute to fatigue. Noise levels also contribute to fatigue, if high enough for any great length of time. There is pressure, because of the number of performances, no matter how delightful and enjoyable for you and the audience. Rest and sleep are absolute musts for the performers at Theme-Parks. Correct eating habits and proper nutrition are also necessary to maintain energy levels and strength. Certainly unions watch over you, by contract, but you must also add your individual initiative in human care of yourself. This goes for the performer and the technican alike.

If you happen to be one of the cartoon characters in an animal costume, then there are other hazards. Some Theme-Park employees have filed grievances about some of these areas. The costumes are safety-engineered. Venilation, sure-footedness, flame retardancy of materials, all these are part of the safety engineering. The heat can get up to 140 degrees.

Some of the costumes are built of plastic, felt, leather, yarn, cotton, polyester and canvas. The materials have been used to reduce the weight factors, and some of the heat factors too. However, the effects of temperature extremes, be they hot or cold, can be detrimental to anyone, actors notwithstanding. Man functions only in very limited body temperatures. Above or below that, impair, markedly performance of the human being. Beyond five degrees, hygienists tell us, a health hazard exists. Heat stress and heat stroke can take place. Energy levels are reduced with too much heat. These areas are of concern to OSHA and State inspectors. Although one does not wish to do away with humans in animal and cartoon costumes, the efficiency and health level in these costumes must become much better.

To add insult to injury, the childlren of all ages and sizes, take delight in kicking, pinching and generally brusing these animal characters. Yes, they even kick and bite them. Ah, the life of a cartoon character, is not even safe. True, there are hazards in every line of work, and acting is no exception. We hasten to add, the costumes are flexible, few parts to catch on anything, strong material is used, they are well designed and maintained, and they fit properly.

There are shows which utilize live animals, as well as those Theme-Parks which have large pieces of land with many animals from the jungle, loose within those confines. Yes, accidents can happen. Rules are set up, regulations are enforced stringently for the safety of the patorn, but some people infringe upon those regulations. When this occurrs disaster and death do occur. If you are employed by the

initiate the regulations with rigidity, for the lives of all concerned. Their safe passage through the Theme-Park animal compounds, no matter how large or small, is a matter of life and death.

If you are hired as a animal tender, precautions must be exercised as in the cases of all the Theme-Park employees. 1. You must be always conscious of the interplay between the customers and the animals, especially small children.2. If customers are allowed to feed the animals, keep close watch that the eager children and the hungry animals do not buffet one another.

It is becoming a standard practice for some Theme-Parks to place plexiglass between some animals and the audience. Eagerness on both parts could be unsafe, without this piece of equipment. Always treat animals with respect, when you are tending them. They are used to the excitement that is constant and are fed and motivated that way by their trainers, but as an attendant, caution is always your rule. Observe carefully the trainers and follow their guidelines, both for you and for the customers.

Rides: Kiddie Rides, middle children rides, teen rides, medium exciting rides, and the "white knuckler" or high thrill rides. Each Theme-Park tries to outdo the other, in most instances. There are some exceptions. Bigger, higher, faster, more loops, more curves, more people. The roller coaster and the parachute are the best examples of this competition.Next comes the skylifts and the flume rides. All guaranteed to get you wet from perspiration or drenching.

Thrill rides. Safety practices in these areas are highly rigid. Personnel are trained very carefully, and must be extremely alert. 60 m.p.h. in 1200 yards of track, strapped-in doubly, is high excitement. No chances are taken. Safety ratios for steel, for weight, for stress, for heat and for deflection are measured very carefully in the design and construction of these high speed rides. Twenty story high parachute drops also have built in high safety ratios for wire rope and cable and crosby clips. Limit switches are also of the highest caliber. Testing is done over and over again. Air pressure tanks , and brakes on all high speed and drop rides are checked over and over again, and checked while they are operated during the day.

Some of the high speed thrill rides requre two people to go in them. They will not allow one person to go up. You must sit with another person and both of you are held in by bars and you have handles to hold onto for safety.

Age limits are kept also. There are roller coasters and special rides for the young or kiddie group. Two decker carrousels and carrousels built on the hovercraft principle at one Theme-Park, are becoming very popular.

Skylifts have doors locked. Attendant is given definite training in each of the thrill rides, and specifically, safety precautions for the ones he is running. He or she is the key to these safety compliance regulations for the customer. Others assist him, but he still must apply these regulations.

Some rides will not let children of a certain size on them. As an attendant, observe that rule of the Park rigidly. Too small a child

may slip out of the safety harness. Keep in mind, the rules were made for the health and safety of all.

If you are employed at a Theme-Park, it is a good idea to keep in mind another aspect of your training. People, thousands of them, especially for the rides, are waiting in lines, sometimes for over an hour. They get tired, fatigued, some even faint. Some have to go to restrooms. Keep in mind the stress factors on the customers. They like you, may have been at it all day, are away from home, noise factors get to them, screaming, etc. Be very alert and attentive to those needs.

If you are a knowledgeable technician, in some area of the entertainment spectrum, and you think that you want to work at one of the thirty or more Theme- Parks in the country, remember, you can call upon the skills you have learned and practiced, but the Theme-Park becomes the ultimate in Entertainment, because there is more of everything, more of the time. In some ways its a rigid, disciplined way of life. One thing you can bet your life on, nearly literally, Theme-Parks are conceived, designed, engineered, constructed and operated with the health and safety of all in mind. They seem to believe there is no other way to do business, Would that the rest of the entire entertainment industry take their cue from Theme-Parks.

Dr. Randall W.A. Davidson, President of International Safety Institute, Inc a Safety and Loss Control corporation dedicated to saving lives and resources in the Public Assembly and Entertainment Industry.

Author of numerous articles on safety and health; involved in the Entertainment Industry for over forty years; member of the American Society of Safety Engineers; Commissioner of Safety for the U.S. Institute for Theatre Technology, Inc. (USITT)

APPENDIX E

ANNOTATED BIBLIOGRAPHY OF TECHNICAL PUBLICATIONS

PERTINENT TO CROWD CONTROL AND MANAGEMENT

APPENDIX E Annotated Bibliography of Technical Publications Pertinent to Crowd Control and Management

R. A. Beck

Northwestern University
Evanston, Illinois 60201

"A Gaming Approach to Crowd Behavior"

American Sociological Review, 1974, 39, June, 355-373

ABSTRACT - A presentation of an argument that proposes that emphasis on the irrationality of crowd behavior is at best misplaced. Building on a detailed examination of a particular instance of crowd behavior which took place on the campus of Northwestern University, Evanston, Illinois, in May of 1972, and a blend of several different theoretical perspectives, a new approach to crowds is proposed, in which participants exercise considerable cognitive skill while consciously trying to produce concerted rewarding action. The affects of environmental conditions, and factors are considered for an enumerated evaluation of collective decision-making in crowds. Based on Decision Theory, two traditions for a "gaming approach to crowds" are discussed. The events at Northwestern University are analyzed through use of a revised collective decision-making approach offering supported for the proposed concerted rewarding action.

John T. Cheffers
Benjamin Lowe
Roger D. Harrold

Boston University

"Sports Spectator Behavior Assessment by Techniques of Behavior Analysis"

International Journal of Sport Psychology, 1976, Vol. 7(1), 1-13

ABSTRACT - Presents the thesis that sports spectator behavior is predictable. A methodology for analyzing collective behavior at sports events is described: The individual reaction gestalt (IRG), based on techniques of interaction analysis. Implementation of the technique depends on training groups of observers to code behavior. The technique maintains the integrity of the sports crowd in the natural laboratory setting of the sports stadium.

I. Goldaber

International Association of Chiefs of Police
Gaithersburg, Maryland 20760

"Yet a New Kind of Violence"

Police Chief, V 41, N 4 (April 1974), p. 46, 1974

ABSTRACT - Discussion of violence that has erupted in sports arenas around the country and the accompanying crowd control problem that faces ushers, guards and police. Psychological causes of this phenomenon are analyzed.

J. P. Gunning

Virginia Polytechnic Institute and State University
Blacksburg, Virginia 24061

"An Economic Approach to Riot Analysis"

Public Choice, 1972, 13, Fall, 31-46

ABSTRACT - A riot is defined as an unlawful act (or set of unlawful acts) committed in the presence of a crowd which is sufficiently large and/or sympathetic that ordinary law enforcement procedures are inadequate. The economic model of behavior asserts that an act is the (sometimes indirect) result of a conscious choice. The criteria for choice are defined to be the subjective benefits and costs. Thus, to reduce riot, one need only to alter the nature of the benefits and cost. Before one can do so, however, he must identify the benefits and costs that appear to be relevant. The potential benefits to riot participants are delineated. On the basis of this typology, eight different ways of reducing riot participation are identified. The inefficiency of group punishment in reducing riot participation is discussed. Since there are various alternative means of reducing participation, the policy-maker is faced with a choice. The alternative he chooses will probably depend largely on his own evaluation of the importance of the well-being of the various types of riot participants and of the well-being of taxpayers who must pay the bill. In essence, he must make an ethical judgment (at least implicitly). Two such judgments and the type of riot-prevention recommendation that would be redistributed in favor of rioters would lead to a recommendation of the techniques which appear to be the most popular. The judgment that the deterrent power of laws should be the same under all circumstances leads to the advocacy of higher penalties for persons who riot.

N. R. Johnson
Maryline Glover

University of Cincinnati
Cincinnati, Ohio 45221

"Individual and Group Shirts to 'Risk': Two Laboratory Experiments on Crowd Polarization"

ABSTRACT - Crowd behavior is regarded as an example of the "risky shift" or group polarization. It is hypothesized that polarization occurs because of: (1) the shift in individual choices (polarization), and (2) the shift in crowd composition due to individual entering and leaving the crowd situation. Two small-groups experiments, viewed as analogous to crowd situations, were conducted. Experiment (1) focuses on the shift to risk by individuals in a closed system, while Experiment (2) creates an open system in which the "observers" may enter and crowd "members" may leave and focuses on shifts due to composition changes. Generally, the results support both hypotheses.

APPENDIX E (continued)

N. R. Johnson
Deborah Hunter
James G. Stemler

University of Cincinnati
Cincinnati, Ohio 45221

University of Portland
Portland, Oregon 97203

"Crowd Behavior as 'Risky Shift': A Laboratory Experiment"

Sociometry, 1977, 40, 2, June, 183-187
American Sociological Association
1722 N Street, N.W.
Washington, D.C. 20036

ABSTRACT - Crowd behavior can be conceptualized as an example of "risky shift" insofar as crowds shift either to caution, which causes their dispersal, or to boldness, which causes more radical actions that individual members might favor. A number of collective protest actions are arrayed on a "riskiness" dimension to form a Guttman scale. Questionnaires dealing with choice of an action in each of four circumstances were given to 76 male and 76 female college students organized in same-sex groups, both for individual completion and for subsequent group choice on a unanimously preferred alternative. It is hypothesized that group choices will show willingness to tolerate higher levels of maximum risk than will individual choices; results support this hypothesis.

L. D. Libby

Federal Bureau of Investigation
Washington, D.C. 20535

"Seattle Police Special Activities Section - How to Provide Maximum Police Service at Minimum Cost"

FBI Law Enforcement Bulletin, V. 47, N 9 (September 1978), p. 16-21

ABSTRACT - Efforts of the police department's Special Activities Section (SAS) in Seattle, Washington, to provide adequate service under budgetary constraints are addressed. The SAS often must provide more than 250 police officers as a security force for activities such as rock concerts and professional sporting events. The police department consists of approximately 1,000 sworn officers, with 650 assigned to the uniformed patrol bureau and traffic division of the department. Consequently, there are not 250 officers available for security force duty. The SAS is headquartered at the Seattle Center, a complex of cultural, entertainment, and convention facilities including the Metropolitan Stadium and three auditoriums. The Center was the reason for the SAS unit's existence. The first regular assignment of police personnel to the center was in 1965. Responsibilities of the SAS are varied, but one of the most important functions

APPENDIX E (continued)

from a police point of view is the provision of security at center events. The thriteen officers in the SAS obviously cannot provide adequate security at an event with an attendance of 15,000. Particularly if that event is a popular rock group. To minimize expenses of the SAS, promoter of events at the Center are required to make direct payment for security services to a private accounting firm. In addition, there is a volunteer reserve unit comprised of unpaid officers who work under the direct supervision of sworn officers. These volunteers fulfill the SAS' responsibility for moving traffic through the main parking area of the center. A group of young volunteers is employed by the SAS to deal with crowd control at various center events. The SAS also is involved in providing for security at the 65,000-seat Kingdome Stadium. The Crimes Specific Section of the police department augments efforts of officers in the SAS.

Elizabeth Mackintosh
Sheree West
Susan Saegert

Graduate School and University Center
The City University of New York
33 West 42nd Street
New York, New York 10036

"Two Studies of Crowding in Urban Public Spaces"

Environment & Behavior, 1975, June, Vol. 7(2), p. 159-184

ABSTRACT - Conducted two studies in densely populated public urban places to (a) determine whether information overload occurs as a result of large numbers of people in close proximity (high density) and (b) measure the performance and emotional consequences of high density settings. Study 1, which investigated cognitive clarity, compared descriptions from 28 female students who were exposed individually for 30 minutes to either crowded or uncrowded conditions in a shoe section of a department store. Crowding affected incidental recall (accuracy of maps drawn after the exposure) but not focal recall (descriptions of shoes and people made during the exposure). Study two, which examined affective responses to overload compared reactions of 20 male and 20 female New York City adults; subjects were exposed for 30 minutes to either crowded or uncrowded conditions at a railroad terminal. Half of the subjects received an orientation to the terminal (tour and map). Neither density nor orientation affected performance on simple, inconspicuous tasks typically found in the setting (performed during exposure). Density, however, affected emotional reactions (measured after exposure). Sex density interactions for emotional reactions are examined.

A. P. Mcentee

International Association of College
and University Security Directors
Atlanta, Georgia 30329

"Stadium Rock Concerts - Survey"

Campus Law Enforcement Journal, V. 7, N 3 (May-June 1977), p. 46-47, 1977

ABSTRACT - This article is the result of a survey taken of university police departments in discerning common problems in providing police services for large events such as rock concerts. Seven common concerns were expressed by the police agencies: early arrivals creating health, safety and party problems; traffic control; involvement in the total community; crowd management and control; medical concerns; clean-up and repair; and external community relations.

Stanley Milgram
Leonard Bickman
Lawrence Berkowitz

The City University of New York
33 West 42nd Street
New York, New York 10036

"Note on the Drawing Power of Crowds of Difference Size"

Journal of Personality and Social Psychology, 1969, 13(2), 79-82

ABSTRACT - Reports on the relationship between the size of a stimulus crowd, standing on a busy city street looking up at a building, and the response of passersby. As the size of the stimulus crowd was increased a greater proportion of passersby adopted the behavior of the crowd. Subjects were 1424 pedestrians. The results suggest a modification of the J. S. Coleman and J. James model of the size of free-forming groups to include a contagion assumption.

Susan Saegert

University of Michigan

"Effects of Spatial and Social Density on Ardusal, Mood and Social Orientation"

Dissertation Abstracts International, 1974, January, Vol. 35(7-B)

DESCRIPTORS - Overpopulation, personal space, emotional responses, physiological ardusal, social behavior.

IDENTIFIERS - Spatial and social density, physiological and behavioral ardusal and mood and social orientation.

M. J. A. Stark
Walter J. Raine
S. L. Burbeck
K. K. Davison

California State University
Long Beach, California 90804

"Some Empirical Patterns in Riot Process"

American Sociological Review, 1974, 39, 6, December, 865-876
American Sociological Association
1722 N. Street, N.W.
Washington, D.C. 20036

ABSTRACT - Studied is the riot process. Detailed temporal and spatial data on over 1,850 instances of crowd action recorded during the Los Angeles riot are categorized, quantified and analysed. Data are generated using an adaptation of team reporting in which a number of segments, or pieces of behavioral action, are combined to increase the amount of information available on a complex event. Common crowd characteristics and riot clafficatory and conceptual schemes using monolithic concepts ("generalized belief," "the foray of pillage," "the rampage") fare poorly under the scrutiny of a large-scale empirical inquiry. The emerging patterns indicate the need for studies which approach collective violence as a complex, diverse and dynamic behavioral process. Two Figures, two tables and Modified HA.

T. J. Sullivan

Northern Michigan University
Marquette, Michigan 49855

"The 'Critical Mass' in Crowd Behavior: Crowd Size, Contagion and the Evolution of Riots"

Humboldt Journal of Social Relations, 1977, 4, 2, Spring-Summer, 46-59

ABSTRACT - Ghetto riots are typically analyzed in terms of the prior sociological and social psychological conditions which motivated them. This ignores the question of why they occurred in a specific place and at a specific time. A process approach is appropriate to this question, for which riots arise due to the communication and social interaction at the scene of a potential riot. The likelihood of a disturbance can be conceived as probabilistically related to the number of potentially precipitating events which occur and to the likelihood that one of them will cause a critical mass of people to form. This offers a means of reinterpreting previous findings about riots. One figure.

APPENDIX E (continued)

Joe Shirley

Atlanta Braves
Atlanta, Georgia

"Stadium Security: A Modern Day Approach to Crowd Control"

FBI Law Enforcement Bulletin, V. 49, N 8 (August, 1980), p. 22-25

ABSTRACT - Stresses importance of stadium security liaison with local, State and Federal law enforcement agencies, security force presence at key access points, video taping of incidents for later forensic uses, and availability of emergency medical services including evacuation by ambulance. States that "An otherwise law-abiding citizen experiences the safety of anonymity in a crowd. That feeling of anonymity can be removed by breaking up the crowd, by using a camera, and by shouting explicit orders while pointing at a specific individual."

Stephen B. Flynn II

Specta Guard, Inc.
Philadelphia, PA

"Matching the Mood"

Security Management, V. 25, N 8 (August, 1981), p. 50-54

ABSTRACT - Describes successful practices of a security and ushering services company responsible for event as well as 24-hour security for a variety of sports, fine arts and entertainment facilities. Discusses how of crowd control psychology informed management decisions, stressed selection factor in recruiting security personnel, new communications devices and pre-event advisories broadcast over local radio stations.

APPENDIX F

REVIEW OF DBR/NRCC (CANADIAN GOVERNMENT) STUDIES OF MOVEMENT OF PEOPLE, 1967-1981

REVIEW OF DBR/NRCC STUDIES OF MOVEMENT OF PEOPLE, 1967-1981

by Jake Pauls
Division of Building Research
National Research Council of Canada
Ottawa

31 August 1981

This review, for which only an outline appears below, is being prepared primarily for participants of the International Life Safety and Egress Seminar to be held at the University of Maryland, 23-24 November 1981. The outline is being made available for an appendix to a report on the National Bureau of Standards workshop on crowd ingress to places of public assembly, held at NBS in May 1981. The review is the first complete record of the sites, methods and output of DBR/NRCC research (by Pauls, Johnson, Henning and others) on movement of people in and around buildings. Some preliminary findings of field studies, which formed the bulk of the work, will be outlined in the complete review.

An indication of the evolution of the work is given by the titles of DBR/NRCC projects headed by Pauls who directed the majority of the work outlined here. From 1967 to 1970 the title was "Geometry of building spaces." It is noteworthy that during this period the title "Responses to emergencies in buildings" was used for Pauls' undergraduate thesis (Ref. 1). This reflected an early interest in broad behavioral issues that influenced studies conducted subsequently at DBR/NRCC and possibly elsewhere. From 1971 to 1974 the title was "Egress arrangements in buildings." The current project title, dating from 1974, is "Movement of people in buildings." Administratively the project has existed in three successive DBR sections: Building Use Section, Building Design and Use Section, and Building Performance Section.)

The project began with an abstract, geometrical approach with emphasis on topological aspects of egress systems. It very soon broadened to include human behavioral aspects but with the focus of attention still very much on egress. In its maturity there was a widespread concern for human movement in and around buildings including both ingress and egress, problems faced by disabled persons and psychological factors relating normal and emergency conditions. What started as research on building geometry quickly became applications-oriented research dealing with behavioral and management aspects influencing not only major emergencies but also everyday safety, amenity and cost effectiveness. (Stair use and design has received particular attention throughout this work.)

Beginning in 1974 opportunities for field studies quickly began to overwhelm the resources available to analyze data and publish findings. By the time of the massive Olympic Games field study in 1976 it was clear that the many records produced by these studies could not be entirely analyzed and published. Another strategy was developed. This emphasized complete indexing of film and video records followed by partial analysis on a problem-oriented or demand basis. Thus a long-term resource was being built, a resource that could be accessed readily for particular data analysis when particular questions arose. (Incidentally, this resource also includes several thousand 35-mm slides.)

Using special perimeter-punched "key-sort" index cards produced for about 800 separate films and videotapes one can in minutes determine, for example, which films and videotapes deal with crush-type crowd entry phenomena at entrances to buildings. Qualitative or quantitative data, relevant to the problem at hand, can then be generated from the visual records found in the search. The latest version of indexing system is outlined in Appendix A. Further information about the indexing system is found in references 2 and 3.

The following is an outline of the studies. Numbers in parentheses refer to publications and other output (totalling over 1100 pages plus one documetary film) describing the studies, their findings and recommendations. These references are listed following the outline of studies. Not included in the references are brief reports to officials and others requesting some of the studies noted below for particular buildings. Also omitted are DBR/NRCC digests or practice-oriented papers, based largely on work by others outside DBR/NRCC, on movement problems faced by disabled persons. (In addition to extensive coverage in mass media the research on movement in buildings was also described in conference and seminar presentations - about 100 since 1971.)

1967-1968: "Desk research" on geometry of building spaces.

1969-1974: Observations of evacuation drills in tall office buildings. Emphasis was on crowd egress down exit stairs (4-27).

1971: Survey of physical features of stairs in Ottawa.

1971-1976: Filming, videotaping and direct observation of crowd movement in shopping plazas, cinemas, theaters, arena and stadium in Ottawa (28-31).

1974-1975: Filming, videotaping and direct observation of crowd movement in the new Calgary Stampede Grandstand.

1975: Field and laboratory data collection relating to difficulties in patient movement via stretchers in elevators and on stairs (32).

1975: Filming, videotaping and direct observation of crowd movement in new grandstand of Exhibition Stadium in Toronto.

1975: Filming and direct observation of crowd movement in GO Transit facilities at Union Station in Toronto.

1976: Filming, videotaping and direct observation of crowd movement in Place des Arts opera house in Montreal.

1976-1978: Filming, videotaping and direct observation of spectator movement in Olympic Park and transit system in Montreal. This was the largest single field study undertaken, totalling over 3,000 person-hours of work by a ten-person study team in the summer months of 1976. Approximately 85 hours of film and video records resulted. A minor portion of this work involved advisory activities requested by Olympic Games organizers, facility managers and transit authorities in Montreal (33, 34).

1977: Videotaping and instrumented collection of data on normal use of stairs and elevators in three Ottawa office buildings (35, 36).

1978: Filming and videotaping crowd movement, under controlled conditions, on stairs at DBR/NRCC in Ottawa. This study, plus two earlier tests, repeated some influential classical tests of high flow.

1978: Filming, videotaping and direct observation of spectator movement in the Coliseum and new Commonwealth Stadium in Edmonton. This study, undertaken by a six-person documentation team, focused on spectator movement on long, steep aisle stairs. Approximately 50 hours of carefully sampled film and videotape resulted. A minor component of the work dealt with broad system aspects including management and transit services (2, 3, 37-42).

1978: Videotaping circulation in an elementary school in Ottawa for data on energy loss through opened doors.

1978: Filming, videotaping and instrumented collection of data on use of doors by disabled persons (in field and laboratory settings).

1978: "Desk research" on security and building circulation (44-46).

1978-1979: Filming and direct observation of movement of people on new Robson Square stairs and ramps in Vancouver.

1979: Filming and videotaping spectator movement in aisles of Exhibition Stadium in Toronto.

1979-1980: Filming, videotaping and direct observation of spectator movement in newly expanded Winnipeg Arena.

1980: Filming and videotaping door use by individuals and crowds in Vancouver (47).

1980: Direct observation of crowd behavior in a rock concert at Exhibition Stadium, in Toronto (48).

1980: Photography and direct observation of spectator movement in aisles of McMahon Stadium in Calgary.

1980: Photography of quarter-scale stair models and mannequins showing stair use problems. This was done for presentation and research purposes.

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APPENDIX A

INDEXING SYSTEM USED BY DBR/NRCC FOR FILM AND VIDEO RECORDS OF PEOPLE MOVEMENT

This system, the latest form of which is described in references (2) and (3), makes use of 5-inch by 8-inch perimeter punched, "keysort" cards, one for each numbered film and videotape record. On the front face of the cards, using a standard format, are recorded information on:

Where the recorded action took place.
Time of filming or videotaping.
Sampling method.
Person operating the film/video equipment.
Identifying numbers of films/videotapes preceding and following.
Numbers of films/videotapes of same action with different views.
Technical details (film type, camera settings, etc.).
Highlights of the record (with identifying frame numbers).
Special entries required by certain indexing terms.

The front face also has two 35-mm contact-print frames of the most busy and least busy shots on the film/video record to permit visual searches where it is important to determine what range of activity is recorded. The back face has space for recording information about subsequent analysis and refers to particular data files.

Of the 102 usable indexing positions on the perimeter of the card only 79 are currently assigned to particular search items which are grouped as follows:

FACILITIES:
Seating, standing facility
Aisle, cross-aisle
Corridor, lobby, concourse
Ramp
Stair
Handrail
Escalator, moving walkway
Concession
Door, doorway, gate, vomitory
Turnstile
Plaza, promenade, open concourse
Sidewalk
Transportation system
Washroom
Cluster generator
Disarray

ENVIRONMENTAL CHARACTERISTICS:
Geometric nonuniformity
Irregular wall surface
Misleading cues
Cognitive errors
Other defects
Information sources
Steep pitch
Unusual scale
Obstacle
Skewed abnormal geometry
Vendor
Unsheltered facility
Hazards

CHARACTERISTICS OF USERS:
Footwear
Upper encumberances
Young users
Elderly users
Sex
Handicapped users
Helping behavior

CHARACTERISTICS OF MOVEMENT:
Open (crowd spacing)
Impeded "
Constrained "
Crowded "
Jammed "

CHARACTERISTICS OF MOVEMENT (Cont'd.):
Density (codable)
Speed "
Flow "
Intra-event movement
Ingress
Egress
Body contact
Group configuration
Queuing
Path choice, mixing
Merging
Crossing conflicts
Deference behavior
Gait
Cadence
Crabwise gait
Missteps
Stumbles, arrested falls, accidents
Body sway
Fast athletic style
Handrail
Cross-over behavior
Special & idiosynchratic behavior

RATIONALE OF FILMING & MISC:
Calibration
Very good image quality
Very poor image
Crowd attraction
Views of setting
A-level sampling (site scale)
B-level sampling (building scale)
C-level sampling (facilties and context)
D-level sampling (single facility)
E-level sampling (micro-scale)
Aerial view
Frontal/back view
Lateral view
Unusual camera orientation
Camera follows subject

References (2) and (3) describe the development and use of this system.

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5. AUTHOR(S)

Francis T. Ventre; Fred I. Stahl; and George E. Turner

6. PERFORMING ORGANIZATION (If joint or other than NBS, see instructions)

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10. SUPPLEMENTARY NOTES

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

11. ABSTRACT (A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)

The movement of large crowds into places of assembly has resulted in death and injury to facility patrons and staff. Facility designers and managers seeking guidance have found little relevant information in the technical literatures of architectural and crowd control. The Law Enforcement Assistance Administration and the National Bureau of Standards convened the most knowledgeable persons in North America in the topic of crowd ingress to places of assembly to: identify best current design practices; identify best current facilities management practices; and define research needed to support improved practices in design and management. The report documents the design and management practices suggested by the assembled experts, reports related activities of the International Association of Auditorium Managers and suggests a program of research leading to improved quantitative design and evaluation procedures for crowd ingress.

12. KEY WORDS (Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)

Auditorium; building standards; crowd ingress; design procedures; evaluation procedures; facility design; facility management; public assembly; public safety; stadiums.

13. AVAILABILITY

☒ Unlimited

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